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AGRICULTURAL RESEARCH INSTITUTE
PUSA

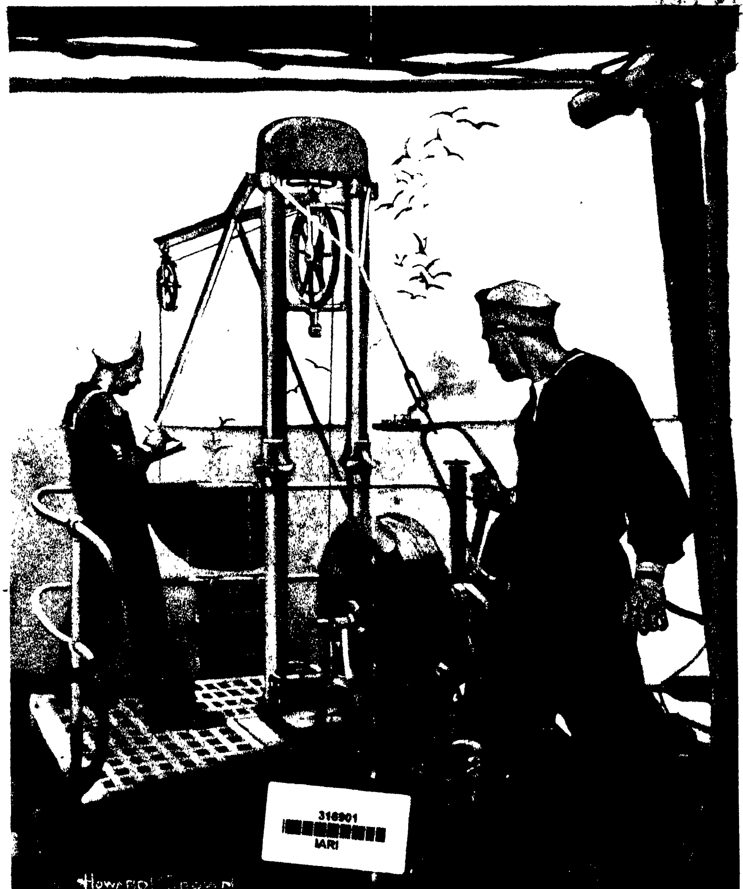
. *IN THIS ISSUE:*

TOMOTIVE MILESTONES,
ERE IS THAT RATTLE?

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



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EXPLORING THE OCEAN BOTTOM WITH THE DEEP-SEA SOUNDING EQUIPMENT.—[See page 10]

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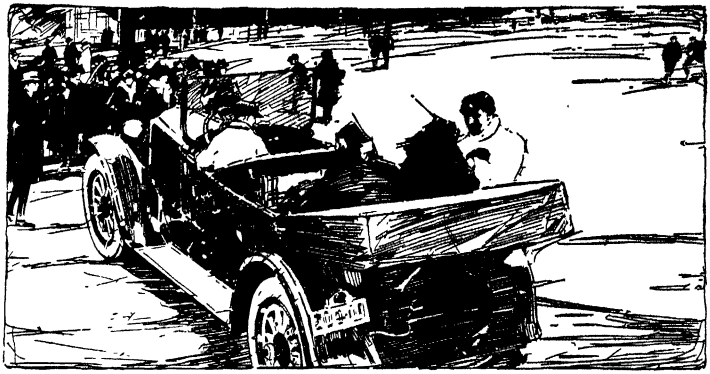

You never know what a car can do until you get a Packard

AFTER all, the chief difference between the Packard and some other car is very easily stated.

It is the difference between giving the owner *everything he can make use of*—or building down to the least he can ask of his car.

If there were any compromise anywhere in the Packard Car; any attempt to build down to a competitive price basis; any feeling in the Packard organization that the American public can be influenced by pose or "side" or talk of "What they do in Europe"—the Packard could not be the *practical car* it is.

There are a number of cars with high power ratings.

Yet you see the Packard running all around them.

It is the same way on the hills as on the level road; and the first car to shoot out of the traffic jam is a Packard.

You will hunt far before you find a car of equal size that does its work on such a slight expenditure for gas and tires.

The thing that sets the Packard apart is its *forethought for all the use* a man can make of his car.

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TWIN SIX

is built to give the owner everything he can make use of – no compromise.

SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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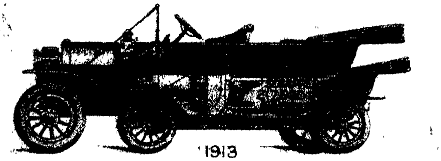
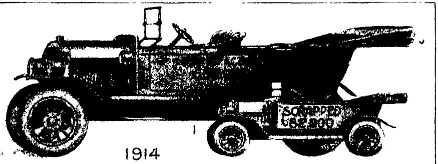


1913



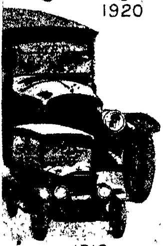
1914

1920

1915

	For the year			Total 1899 to year named			Total put in service in United States up to year named	Registration for the year	Total cars eliminated up to year named	Cars eliminated in year named
	Manufactured	Imported	Exported	Manufactured	Imported	Exported				
1899	3,700			3,700			3,700			
1900	4,800			8,500			8,500			
1901	6,300			14,800			14 800			
1902	8,300			23,100			23,100			
1903	11,000			34,100			34 100			
1904	21,975			56,075			56 075			
1905	25,000			81,075			81,075			
1906	34,000			115 075			115 075			
1907	44,000			159,075			159 075			
1908	65 000	1,045	3,000	224,075	1,045	3,000	222 120			
1909	127,731	1 624	6 000	351,906	2,669	9,000	345,475			
1910	187 000	1,473	9,000	538,806	4,142	18,000	524,948			
1911	210,000	888	10,000	748 806	5 030	28,000	725 836			
1912	378,000	963	18,000	1,126,806	5,993	46 000	1 086,799	1 009 513	77 286	
1913	485,000	748	25,286	1,611,806	6,741	71 286	1 547,261	1,253,034	294 227	216 941
1914	569,045	300	29 090	2,180,851	7 041	100,376	2,087 516	1 711,339	376 177	81,950
1915	892,618	322	37,876	3,073,469	7,863	138,252	2,942,570	2,445,664	496,906	120 729
1916	1,583,617	1,474	77,499	4,657,086	8,837	215 751	4 450,172	3 512 996	937 176	440 270
1917	1,868,947	105	80,779	6 526,033	8,942	296,530	6 238,445	4,983,340	1,255 105	317 929
1918	1,153,637	50	47,244	7,679,670	8 992	343,774	7,334,888	6,146,617	1 188 271	66,834
1919	1,974,016	117	82,730	9,653,686	9 109	426,504	9,236,291	7 558 848	1 677 418	489 172
1920	2,350,000	200	100,000	12,003,686	9,309	526,504	11,486,491	9,000,000	2,486,491	809 048

THE production figures for 1899, 1904, 1909 and 1914 are from the Federal Census, for 1917 and 1918 from the manufacturers' sworn statements to the War Industries Board, for 1900, 1901 and 1902 they are estimated by the SCIENTIFIC AMERICAN on the basis of a constant percentage of annual growth between 1899 and 1903, for 1920 the best estimate available has been used and for all other years the figures compiled by the National Automobile Chamber of Commerce All import figures to 1919, and all export figures from 1913 to 1919 inclusive are those of the Bureau of Foreign and Domestic Commerce For 1920 the SCIENTIFIC AMERICAN has estimated both these items, the former on the assumption of a percentage of increase identical with that of 1919, the latter on the basis of uniform percentage of production as against 1919 The imports for 1908 to 1912 are likewise estimated by the SCIENTIFIC AMERICAN on the basis of a substantially constant percentage of the annual production, as indicated by the export figures for 1913 and 1914 The registration figures are those of the National Automobile Chamber of Commerce, except that for 1920, which is again an independent estimate, but which if anything is too low All figures are for passenger cars and trucks combined, but do not include motorcycles or tractors



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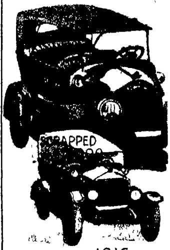
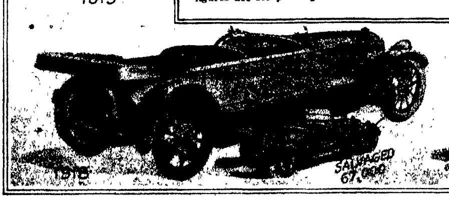
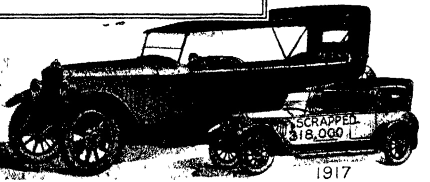


1916



1918



1917

The above table shows at a glance the status of automobile manufacture and use in the United States, from the very beginning, so far as figures are available or can be reasonably estimated. The manner in which the figures in the later columns are obtained and those from the earlier will be plain from examination of the table. Special attention must be given the entry for 1918 in the final column, which shows that there were enough cars salvaged from the waste of previous years to create a net gain for this year of 67,000 cars, over and above all the new cars put into service. This is brought out in the graphic comparisons of the border

THE HISTORY OF THE AMERICAN MOTOR CAR INDUSTRY TOLD GRAPHICALLY AND IN FIGURES

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs

Review of the Year 1920

Readjustment

TWELVE months ago, in reviewing the year just closed, we spoke of the clouds of disillusionment which lay broad and heavy upon the world, and expressed the belief that mankind had reached a stage of education and enlightenment, at which there was no reason to fear the revolution and chaos of which the more timorous souls among us were fearful The intervening twelve months since that was written have justified our optimism, for there are many signs that a process of readjustment, slow it may be, but steady, has been taking place We say this even in the presence of the trying period of diminishing production, shrinking trade and headlong fall in prices through which the country is passing It is a healthy blood-letting That the country should endure so quietly a crisis which in any earlier period of its history would have brought a catastrophic collapse is immensely reassuring The fundamental law of supply and demand is asserting itself with unexpectedly swift results, and we are among those who believe that the new year will not have run its course very far before this old world of ours will realize that industrially, socially and politically, it is getting back into its stride

Engineering

Although the world is still suffering from the stupefying effects of the great war, notable work has been done in the broad field of engineering Our railroads, now under private control, are setting their house in order—a task of no little magnitude Effort is being directed to making good the depreciation both in roadbed and rolling stock and such new methods of operation as were tried during the war and found to be of value are being applied, with modifications, under private ownership

That notable waterway the New York State Barge Canal, has been maintained at its full depth during the year The construction of terminal grain elevators and local and terminal docks, and their equipment with the latest freight-handling appliances have been pushed through as far as appropriations would allow Several private companies have been formed for the construction of fleets of barges The Canal has shown that it can carry freight cheaper than the railroads, and in less time between given points The pressing needs of the Canal are that the Government should give up Federal operation of barges, and that a well-ordered campaign of education should be set on foot to place the superior advantages of shipment by canal before the general public

Work on the Panama Canal has been directed mainly to the finishing up of the very fine terminal works, both on the Atlantic and the Pacific, and the removal of material which has moved in from the slides, big and little The Culebra slides are showing decreasing activity as the material reaches its natural angle of repose, and, so far as this difficulty is concerned shipping has now unobstructed passage There has been a steady growth in traffic, and the receipts from tolls now exceed the cost of maintenance and operation

The ambitious proposal to construct a deep-water route between the Great Lakes and the sea by way of the St. Lawrence River has been to the fore this year The Canadians are deepening the Welland Canal to 30 feet, and the stretch of the St Lawrence from Lake Ontario to Montreal is to be canalized and deepened so as to permit ocean-going craft to pass from the Lakes to the Atlantic Because of the joint ownership of the St Lawrence, it is probable that if this enterprise be put through it will be by the combined efforts of the United States and Canada

More than ever throughout the world are attention and effort being directed to the matter of irrigation and the development of waterpower Here in the United States the good work goes on apace It is realized, however, that if we are to develop our abundant waterpower economically, we must coördinate the separate existing plants and those that have yet to be built into certain great systems covering and serving definite areas of the country A plan which is receiving much attention covers the states lying between the Alleghenies and the coast, and between the St. Lawrence and the Susquehanna Rivers Not alone are the waterpowers to be developed, but there will be certain great coördinated central steam electric stations suitably located with regard to the mines and transportation

A noteworthy event in the history of urban transportation was the inauguration of work on the vehicular tunnel beneath the Hudson River, which is to consist of two cast-iron tubes, each 29 feet in diameter Each tube will consist of three sections, an upper and lower air duct and a central section devoted to traffic. No constructional difficulties are expected The main problem, of course, is to provide for effective ventilation It is expected that the plan adopted will completely change the air, if necessary, 32 times an hour The estimated cost is $22,262,000 and the time for construction is set down at three and one-half years

An important and gratifying movement of the year was the revival of interest in the scheme for a bridge across the North River Preliminary steps have been taken to finance this great project, which, with its distributing yard in Jersey City, its terminal station in Manhattan and its elevated marginal freight railway to the Battery, will cost 200 million dollars All of the trunk railroads will make use of the system, and the funds for its construction are in sight

One of the stupendous problems of the future will be to provide rapid transit for the teeming multitudes of our largest cities A recent official report shows that the travel in New York increased from 1,527,000,000 in 1910 to 2,400 000,000 in 1920, and it is predicted that there will be five billions in 1945, and over nine billions in 1995 To take care of this, the present length of tracks must be increased from 616 miles to 1,446 miles, and the tunnels from the present 34 to 76

Naval

Because of the fact that outside of Japan we are the only nation which is doing any warship construction on an extensive scale, the record of new naval work is necessarily confined pretty much to ourselves Japan is doing some shipbuilding, but she is making known practically nothing about it, other than a bare statement of her program, which aims at what they call an 8-8 standard That is, she is building with a view to having two fleets embodying eight of the latest dreadnaughts in each, with a fleet of eight battle cruisers At present she has five dreadnaughts built and three building, and four battle cruisers completed and four building A comparison with our own dreadnaught fleet shows how great is our preponderance of strength We have seventeen dreadnaughts completed, all of which are in commission, and we have seventeen under construction If the "South Carolina" and the "Michigan," each carrying eight 12-inch guns, and of 18-20 knot speed, be included, we have nineteen dreadnaughts completed and in commission Our total strength, then, in ships built and building, is 34 or 36 dreadnaughts. In destroyers we are exceedingly strong, having a total of 235 completed and 70 under construction and authorized Our fleet is poorly balanced. Its glaring defect is the total absence of battle cruisers Six of these have been authorized and a little work has been done upon them. They should be completed, or better, four of them should be completed as battle cruisers and the other two should be redesigned as airplane carriers. Another defect is our lack of fast scouts or light cruisers. We have ten under construction, which should be completed. We need also flotilla leaders, of which we have none. Congress is going to cut heavily into the naval appropriation. Since we are so strong in battleships and so lacking in battle cruisers, scouts and flotilla leaders, we should cease work for the present upon the six huge battleships of 43,000 tons which will cost fully 40 million dollars apiece. They can wait.

The need for going slow on new construction, especially of capital ships, is the more apparent when we remember that the European nations, including Great Britain, have laid down no capital ships and practically no warships of any kind for the past two years. Partly is this due to financial stringency, but unquestionably, at least in the case of Great Britain, it is due also to the recognition of the formidable part which war in the air is destined to play in future naval warfare, particularly as a means of attack with large masses of explosive carried to the battleship in the form of close-up torpedo attack or the delivery of deck-piercing bombs carrying enormous charges.

Merchant Marine

The past twelve months have witnessed a steady growth of our merchant marine. True it is that the total tonnage under construction has decreased from 3,470,748 tons in 1919 to 1,772,193 tons in 1920; but this was mainly due to the completion of the Shipping Board building program Before the war we owned 2,027,000 tons—today the total is 12,406,000 tons. The United Kingdom has about made good the ravages of the war, her merchant fleet now amounts to 18,111,000 tons, or, including the Dominions, 20,143,000 tons Construction of new shipping is bound to be modified by the rapid fall in freight rates and the decline in deep sea traffic At the end of September, 1920, a total of 3,731,098 gross tons was under construction in British yards, and 1,772,193 gross tons was being built in the yards of the United States. Construction in the other most active countries was as follows. Holland, 423,400 tons Italy, 365,313 tons, and Japan, 262,407 tons. The Congressional investigation of the Shipping Board has confirmed experienced shipping men in the belief that the sooner our new fleet is taken out of the hands of the Board and entrusted to shipping companies of experience and standing, the better for the future of the American merchant marine. The ships should be sold to the highest bidder for private operation

Closely associated with the future of our merchant marine is the question of suitable terminal facilities at our leading ports, and notably, at New York, through which passes fifty per cent of the sea-borne traffic of the country It is a matter of common knowledge that our port facilities, both as to docks, piers and freight handling equipment, are in many respects far from conforming to the best up-to-date practise in foreign ports New York is building a new terminal at Staten Island with twelve new piers from 1,000 to 1,110 feet in length and from 125 feet to 209 feet in width The Dock Department is planning also to rebuild some 32 old piers on the Hudson River waterfront.

The technical improvements of the year include an increasing substitution of oil fuel for coal. The "Olympic" and the "Aquitania" are now oil burners They can take on 6,000 tons of oil in six hours, whereas formerly it took four days to coal. On the "Aquitania" the firemen force was reduced 70 per cent. There is no disposition to build ships of the size of the "Aquitania" and the "Leviathan" A tonnage of twenty-five thousand and a speed of eighteen knots seem to meet the needs of the shipping companies of today. A noteworthy fact is the application of the electric drive to the merchant marine; the freighter "Eclipse" and the passenger ship "Cuba" were both equipped with this motive power during the year. The heavy oil engine is established as an economical and thoroughly successful drive for freight ships, and there is a steady increase in the size of the installations, as witness the "Africa," built this year at Copenhagen, of 14,000 tons capacity and driven by Diesel engines of 4,500 horse-power.

Aeronautics

To those of us who looked for a rapid development of commercial aviation following the close of the war, the past year will be something of a disappointment. On the other hand, there have been certain developments both here and abroad of encouraging significance. In Europe, not only have the established passenger routes functioned with regularity and safety, but there has been a growth in air travel which has been full of promise. To the airplane industry as a whole the most important event of the year was the appropriation by Congress of over one million dollars for a service to be operated by the Post Office Department from New York City by way of Cleveland, Chicago and Omaha to San Francisco Other Post Office routes determined upon were Cleveland-Detroit, 95 miles; Pittsburgh-St. Louis, 600 miles, New York-Pittsburgh-Chicago, 735 miles, and New York-Atlanta, 815 miles. This move of the Post Office will call for a large and steady output of airplanes. Government assistance in promoting the new art was seen in the offer of the British Air Ministry of $320,000 in prizes for the best airplanes and seaplanes. Because the advancement shown in the competing planes was much less radical than the Ministry had hoped, only $160,000 was awarded. The monoplane seems to be again coming into its own, and metal construction promises ultimately to replace the present wood, wire and canvas In June of last year, an all-metal monoplane made a non-stop flight of 1,400 miles, and in Germany an all-metal monoplane has carried eight passengers to a height of 22,000 feet. Another promising development is the use of multiple-engined planes with the units so connected up that any one of them may be thrown temporarily out of gear for repairs. With a view to enabling high-speed machines to land at low speed, attempts have been made to produce variable-camber and variable-surface wings A variable-camber wing was used by the Dayton racing monoplane at the Gordon Bennet races this year The French have tested with gratifying results a variable-surface wing in a machine which combines a maximum speed of 125 miles an hour with a landing speed of slightly over 30 miles Another device designed *to assist the difficulties of landing* high-speed planes is the reversible propeller, successful tests of which were made at the McCook Army Flying Field.

Two notable speed tests run off during the year were the race for the Gordon Bennett Cup in France and the race in this country for the Pulitzer trophy The former race was won by a Nieuport biplane with a 300-horse-power Hispano Suiza, which covered 186.45 miles at a speed of 168.4 miles per hour. The three American high-powered machines entered suffered breakdowns, but in the contest at Mineola for the Pulitzer trophy, the Verville-Packard Army biplane, driven by a 600-horse-power Liberty motor, won at a speed of 178 miles and subsequently in a speed test reached a speed for one mile of 183 miles per hour The world's record for one mile is held by de Romanet, who drove his Nieuport at a speed of 191 miles per hour.

Pure Science

As usual, we feel impelled to apologize for the large place which astronomy occupies in our vision of the field of pure science, and, as usual, we must account for this on the ground that so many sciences that used to be pure are now sufficiently defiled by practical application to demand listing under the headings "Electricity" or "Industrial Progress" The outstanding astronomical item of the year was doubtless Professor Michelson's ingenious apparatus for so splitting up and identifying the light from the separate components of multiple stars that we shall shortly have a fund of data as to the sizes, mutual distances and periods, etc, of these objects, which a year ago might have seemed permanently beyond our reach.

On the whole, the astronomical development of the year has displayed remarkable unity This is fast becoming a statistical science. The Lick observatory is making a "census" of the nebulae, and estimates that it will list between 700,000 and 800,000 of them. Kapteyn's remarkable investigations into the distribution of the stars in space, the extent of starry space itself, etc, are another case in point. Everywhere we turn in the world of the astronomer we find him collating thousands of observations, carrying out complex problems in probabilities, falling more and more definitely back upon the resources of the statistician. It doesn't sound as though it would make astronomy more interesting, but the results are of such paramount importance that we can surely make this statement.

When we look over the field of physical science for the outstanding achievement of the year we find nothing that is clearly entitled to that rank, but many items which demand mention More or less tied up with electrical science is the photographic recording of heart beats, holding promise of a highly valued method of diagnosis. Our physicists display a marked tendency to take investigations into sound more seriously than ever before. They are photographing sound waves with the result that they know much more about them than they did; they are using sound as a means of measuring the depth of water; they are using sound as a substitute for sight in enabling the blind to read from ordinary type by means of the optophone which, of course, is not yet on a commercial basis The method of measuring by light interference-bands has been extended during 1920 to the screw thread, always a tough nut for the precision man, and to bar deflection

A fundamental scientific theory formulated during the past year and of vital importance if it stands up is that of Dr. Langmuir on the structure of matter More or less in the same field of electro-chemistry is the work on prevention of rust at high temperatures which has been brought within 1920 to commercial application. An important war-time development brought to its climax is that of "seeing in the dark" by means of the minute heat radiation given off by human beings and objects This is entirely in line with the modern tendency of promoting the infinitesimal to an important rôle in our scientific processes

Two advances in the field of plant biology should be mentioned In the United States new knowledge has been got of the part played by daylight in the promotion of plant growth, and the suggestion is that by properly proportioning the hours during which the plant is exposed to light and to darkness we shall have greatly increased yields In Germany the double end is served, of improving the growth of the plant and disposing of an industrial waste, by the *fertilization* with carbon dioxide of the air above the growing crops

Electricity

On the whole the past year has been a very successful one in the annals of electricity Not only was there marked progress along new and promising lines, but existing ideas were applied to the utmost within the twelve months of 1920. The ever increasing use of electricity in so many different fields obviously calls for more power and still more power, and the past year witnessed the erection of many important power plants, particularly of the hydro-electric type. Indeed, the undeveloped water power resources of the United States have been rapidly reduced to slow moving rivers and tiny mountain streams

With the increase in power plants attention has again been directed to transmission problems, for it is one thing to generate the power and quite another to distribute it over a wide area Material advances have been made in designing insulators for high-tension current—advances which must soon be realized in a practical way in the transmission of current over long distances Slowly but surely electricity continues to make its way into the industrial world, replacing methods which have stood the test of ages During 1920 electric heating continued to gain ground—electric steel furnaces, electric brass furnaces, electric ovens, electric paint dryers, electric high temperature furnaces—these and many other applications grew in number

In the field of electric lighting nothing of a spectacular nature took place However, the opalescent bulb made its appearance in great numbers, evidently meeting with a most cordial reception at the hands of the public Considerable laboratory work marked the progress of the electric lighting art during 1920, and certain advances were scored in the way of high-efficiency, gas-filled lamps, particularly argon lamps, of greater candle-powers, and better methods of distributing the light from such illuminants Very material progress was made in the field of incandescent searchlights, thus bringing the searchlight within reach of many heretofore untouched applications

Remarkable progress has been made in the X-ray field No doubt the leading single instance of progress is the portable outfit designed by Dr Coolidge, which brings the X-ray to the bedside of the patient whether he be in the hospital, private home, battlefield, camp or elsewhere. Meanwhile X-rays have been introduced into the workaday world for such purposes as detecting flaws in castings, locating imperfections in mica sheets intended for electrical machinery, and so on All these applications have called for a tremendous output of tubes, and the past year has brought about the production of X-ray tubes by the thousands—, a miracle in quantity production methods, since heretofore X-ray tubes were the product of skilled metal workers and glass blowers, who turned them out one by one.

The vacuum tube continued to hold a prominent place in the electrical world during 1920 Thanks to the interest taken in these tubes by the leading electric companies and their remarkable laboratories and skilled personnel, the art has forged ahead In its wake have come important improvements in radio communication, and promising results in wired wireless It is interesting to note that the experiments in wired wireless in 1920 gave definite promise of telephoning to Europe over the cables at a no far distant date While dealing with radio communication, it is well to remember the many things undertaken in 1920 which must bear fruit in 1921 Among these is the huge wireless plant being erected at Port Jefferson Long Island, which will enable New York City to communicate with stations scattered over the world A serious attempt, moreover, has been made to introduce radio communication between several American cities And whatever has been done in radio communication has only spurred the wire companies to still greater efforts, such as long-distance through wires increasing the number of messages over a given set of wires by means of automatic transmitters and receivers, and so on

Loud-speaking telephones for addressing thousands upon thousands of persons in the open and for use in noisy shops, the increased use of automatic telephones and other features have marked a successful year for telephone enterprises The radio cable, installed in New York Harbor marked one of the real lessons of the war applied to useful peacetime pursuits

Industrial Progress

The industrial conditions of 1920 form an interesting study in extremes the year began with a serious shortage of labor of all kinds and with the highest wages yet scored in a country known for its high wages, and ended with a business depression which was reflected in the closing down of plants on the one hand and the reduction of high wages on the other Indeed, in the short space of something like three months conditions were reversed the dictation of labor had been replaced by the dictation of the employer strikes were at an end money, hitherto so plentiful, became scarce

But our immediate province is more concerned with what the effect of the labor shortage was along mechanical lines, and what mechanical change took place when economic conditions reversed themselves During labor's régime there were marked efforts to introduce all manner of labor-saving devices in order to obtain maximum output with minimum labor Many worthwhile labor saving appliances made their appearance, with the sanction and even recommendation of labor

It is well to bear in mind that Europe, now rapidly recuperating from the cruel blows of the war, is getting into the business game once more and already European products are reaching our shores in ever-increasing quantities Due to the exchange situation, European products can be sold in the United States at prices which defy American competition in certain lines, even allowing a fair margin for increased tariff All of which must necessarily spur American manufacturers to bend every effort to reduce their production costs to the utmost

Further conversion of war plants took place, with the spectacular sale of several of the extremely large plants built during the war for the manufacture of fighting equipment and supplies From machine guns to sewing machines and phonographs, from steel helmets to ventilators, from time fuses to alarm clocks—these were typical of the getting-back-on-a peace basis movement Meanwhile much attention was given to better transportation means The New York State Barge Canal was put in service, with much promise of extensive employment in the immediate future Several new canal schemes were proposed and received with considerable favor The motor truck was used for longer hauls in preference to the rail routes.

1. An example of specially built body work of high class. 2. A good example of what its makers call "pronounced and fashionable lowness," characteristic of modern body design. 3. Long, rakish lines feature the bodies of the better cars. 4. A modern light sedan of good appearance is useful for many practical purposes

Four bodies which are representative of the latest lines in open and closed cars

The Trend of Design for 1921

A Glance at the Changes and the Continuations of Automobile Practice

By Victor W. Pagé, M.S.A.E.

ONE who is familiar with the degree of standardization that has taken place in the American automobile industry realizes that one cannot expect to find improvements or changes of a radical nature in automobiles from year to year at the present time because the mechanism has been developed to a point of great reliability and one that is not susceptible to any change in its essentials. With few exceptions there has been no marked progress in automobile design during the past year, practically all well-known makes of cars for 1921 will embody the characteristics of the successful models which have preceded them for several years.

The tendency as a whole has been to change body lines very slightly, cars of different makes are beginning to look more and more like each other every passing year. It now takes a quick eye and an expert knowledge of the smaller points in car design to be able to identify many of the leading makes when one passes them on the road.

The low, rakish sporting or speedster type of body that was introduced several years ago is now found on practically all cars except the closed types and here again one finds a similarity in appearance, seating arrangement and general finish on all of the stock closed cars. Body makers who make a specialty of catering to people who have sufficient means to gratify their taste for the unusual have created very interesting special body designs that are quite beyond the reach of the average purchaser of automobiles.

The progress of design for 1921 is marked chiefly by attention to details and not by any changes that are apparent to the inexpert. The conditions are just what they should be in a well-developed industry that has found the need for experimentation with new models past and which realizes that much can be accomplished by improving what already gives successful service rather than by devising new designs, the utility of which may be questioned.

Considering first the power plant, we find that the six-cylinder engine is the type used by the largest number of different car manufacturers, though it is not the most popular if judged from point of numbers because several large quantity producers of cars stick to the four-cylinder type. Two new types of eight-cylinder engines have been developed during the past year, one of which is a V or twin-four form in which the cylinders are placed at an angle of 60° instead of the usual 90° that has been formerly considered the best placing of the engine cylinders. This spacing was used successfully on a number of aviation motors and it was found that by proper attention to design the engines run with very little vibration even though the explosions in the cylinders are not separated by equal periods of time as in the V-engine with the cylinders arranged at 90°.

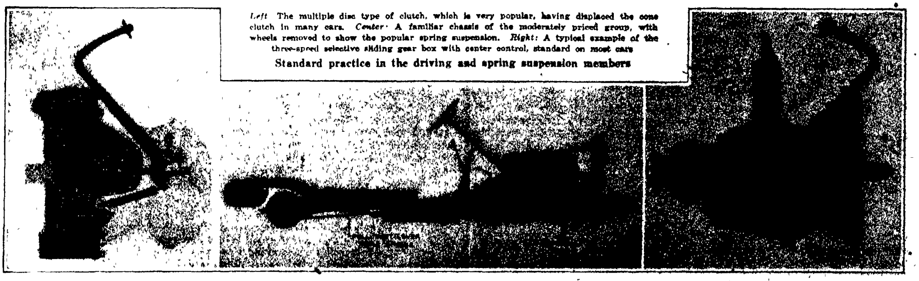
The oiling system of one of the new engines, here pictured, shows the trend of modern practice in positive pressure-feed lubrication

The other new form is one in which the eight cylinders are in one line, a rather unusual placing and one that tends to make a long power plant unless the cylinders are of fairly small size. This eight-cylinder all-in-line-engine has received some attention in Europe, several European makers in the "luxury" car class having decided that it has advantages making it worthy of adoption. The successful use of this engine in record breaking racing cars seems to indicate that it stands a good chance of being installed in passenger cars of that high-priced class that must incorporate distinctive features of design in order to find a market.

The eight-cylinder engine cannot be considered superior to the six-cylinder as regards mechanical balance, because there is a couple which tends to rock the engine in a longitudinal plane. This is because an eight-cylinder all-in-line engine may be considered merely as two four-cylinder engines placed in tandem, and owing to manufacturing difficulties the crankshaft arrangement is usually the same as though two four-cylinder crankshafts had been placed end-to-end, so that the plane of one is at 90° to that of the other. While the inertia forces in the two sets of four cylinders will occur a half-period apart and will cancel each other because they are equal and opposite in direction, this cannot prevent the rocking couple in a longitudinal plane because the forces do not act along the same line.

There has been no marked increase in the use of overhead valves nor has advantage been taken, as it has in Europe, of the experience gained in aeronautical engine construction in which overhead valves are actuated directly by an overhead crankshaft. In this country practically all of the engines in which the valves are carried in the head use rocker arms and tappet rods which extend down to the cam-shaft in the side of the crank case. When engines of the overhead-valve type are used now it is noted that much more care is taken to enclose the valve mechanism by means of pressed steel removable covers, which not only serve to keep the grit and dirt away from the bearings of the rocker arms, but suppress the greater part of the usual clicking noise.

In practically all forms of engines built at the present time, the detachable head feature is advanced as one of the strong points of construction. Makers of engines that for years have refused to change their design in that they continued to build T-head engines with the cylinders cast in pairs are now offering block-cast engines in which all six cylinders are cast together in one unit, and it seems very clear that we are on the straight road to a day when every automobile manufactured will offer access to the cylinder interiors from above, and in no case will it be necessary to separate the cylinder block from crank-shaft and pistons.



Left: The multiple disc type of clutch, which is very popular, having displaced the cone clutch in many cars. *Center*: A familiar chassis of the moderately priced group, with wheels removed to show the popular spring suspension. *Right*: A typical example of the three-speed selective sliding gear box with center control, standard on most cars

Standard practice in the driving and spring suspension members

The situation as regards aluminum pistons is the same as it has been in past years; they have not increased in popularity as much as was expected. Some makers have quietly changed over from aluminum pistons to members of cast iron without advertising the fact and others who formerly used cast-iron have installed aluminum alloy systems in the same quiet way. One maker who formerly favored aluminum pistons has adopted a compromise form in which both cast-iron and aluminum are used. Some of the defects that have been advanced against the aluminum piston by those who do not favor them have been proven to have little weight by other makers who continue to employ them successfully.

A larger number of makers are using balanced crankshafts at the present time, though there has been no change in the situation so far as size of crankshaft is concerned or the number of bearings used for its support.

The auxiliary systems are practically the same as last year excepting that more care has been taken in the new designs to provide means for vaporizing low grade fuels. One prominent maker goes so far as to fit his car with a device built into the inlet manifold which burns a small amount of fuel to give sufficient heat to insure positive vaporization of the remainder The device is said to be remarkably efficient during cold weather, as by its use it is possible to start an engine promptly that has been covered with snow or ice and chilled to the point where it could not be started with the ordinary simple form of carburetor. The "fuelizer" has a spark plug which ignites the fuel supply to the heating portions as soon as the switch is turned on to start the car.

Left. Exterior view of a modern overhead-valve engine, showing the complete enclosure of the working parts *Right*: Partly sectional view of the same engine, showing the working parts

The overhead-valve engine as it is worked out for 1921

In practically all engines one finds heated manifolds to permit satisfactory evaporization of the low-grade fuel which is now being marketed at high-grade prices, and which motorists are forced to use because the rapidly increasing number of automotive vehicles makes it impossible for the oil refiner to supply adequate amounts of high-test spirit having satisfactory vaporizing qualities at even normal temperatures. As the general tendency in engine design is to core the intake manifolds or fresh gas distribution passages in the cylinder block casting and surround them with water, it does not take much time for the engine to heat up sufficiently to assist materially in vaporizing the fluid Some engines have water-jacketed manifolds, while others have the manifold through which the intake gas passes cast integral with or at least placed in close contact to the manifold through which the hot, inert products of combustion are expelled from the engine

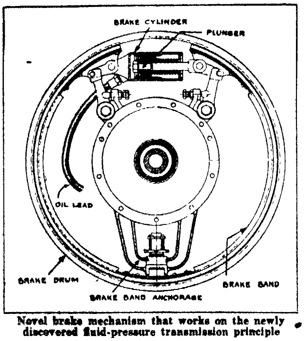
More care is noted in the design of lubrication systems and practically all engines of the better class now use the force feed method in which the oil is circulated through passages cored in the engine base casting or through suitable passages drilled in the engine crankshaft. More attention is being paid to location of the filtering screen which is placed in more accessible positions so it can be easily removed for cleaning.

Battery ignition is generally used in America for passenger cars, only one or two makes of moderate price using magneto ignition. A number of the high priced cars, however, are supplied with the high tension magneto, but their number is so few that it is safe to say that battery and coil ignition in its various forms now controls the situation.

Front-spring suspension of an unusual type

The mounting of the engine, clutch and gear box to form a unit power plant is more general because several makers who formerly installed the gear-box as a separate unit now find it advantageous to incorporate it with the engine by providing the gear case with a flange or bell housing which fits a corresponding member on the engine base that serves to enclose the engine flywheel. The two unit system of starting and lighting is now almost universally used and in practically all cases the starting motor is equipped with a Bendix automatic-shift pinion which meshes with a toothed gear member on the flywheel rim The starting and lighting system units have been so well developed that the average motorist never experiences any trouble with them, barring a "short" in the wiring.

The most popular form of clutch, if considered from the viewpoint of numbers produced and used, is that form known as the three-plate type, in which a single disk is clamped between the flywheel web and an outer pressure member which is brought into contact with the floating plate by means of spring actuated levers. The cone type of clutch is gradually being superseded by the disk type. On most of the medium and high grade cars one finds remarkably efficient direct-drive clutch mechanism in which a series of asbestos-faced friction disks alternate with metal disks, the entire assembly running dry instead of in oil as was formerly necessary when the all-metal-disk types of clutch were popular The three-speed selective type change-speed gearing with center control lever is now the most popular form, as it is found on practically all makes of cars The four-speed gear-box is very seldom used at the present time, only a few makers of the heavier cars favoring it



Novel brake mechanism that works on the newly discovered fluid-pressure transmission principle

As regards the method of final drive from the rear of the change-speed gearing to the rear axle one finds the situation pretty much the same as in years past. Those who favor the Hotchkiss drive, having an open propeller shaft with universal joints at each end, still retain that construction, though some makers who formerly favored this have changed to that form where a radius or torque member is used to supplement the rear spring for resisting braking and driving torque reaction stresses The flexible-disk universal joint in which leather- or rubber-impregnated fabric disks are used is found on an increasing number of car designs. Where the propeller shaft is carried in a torque tube or housing member having a ball joint at the front end we find that but one universal joint is used and that this is usually of the all-metal type.

For final drive gearing, the spiral bevel is applied on practically all cars, only a few of the cheapest makes now using straight tooth bevel gears When the spiral-bevel gear was first introduced it could be manufactured only by costly processes and naturally its use was restricted to those makers who could pay the price for the quieter and more enduring gears The rapid recognition of the merit of this form of final drive resulted in an augmenting demand, which in turn was responsible for the development of special machinery for turning out spiral bevel-gearing of excellent quality in an economical manner. It is for this reason that we find the spiral-bevel gear almost universally used in this country The perfection of this method of final drive has practically eliminated the worm gear in passenger vehicles except a few cars propelled by electric power The worm gear, however, remains very popular in motor truck construction because it is the only form of final-drive gearing that it is practical to use with which the low final-drive reduction needed in truck construction can be obtained with a single pair of gears

Brake design and rear-axle construction have changed but slightly The semi-floating type of axle is now the most popular form and full floating axles are found only on a few makes of cars There seems to be more general application of the transmission brake for emergency purposes, though on most cars using stock axles one finds the conventional internal and external brake-band assembly acting on each rear hub In a new high-grade car just announced for the 1921 season all wheels are provided with brakes, the front as well as the rear In this car the brakes are actuated by hydraulic cylinders of compact form and small size which are placed between the two halves of the open end of the brake band. The method of transmitting motion employed is a modification of the well-known C-C gear which was used during the past war on airplanes so that the machine gun placed at a point where the pilot could not operate the trigger in the customary way could be actuated by a small hydraulic plunger in a suitable cylinder A master cylinder is

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Automotive Milestones

A Digest of the Opinions Expressed by the Leading Automobile Manufacturers

As Reported by Austin C. Lescarboura

IT seems desirable, at more or less regular intervals, that an art like the automotive one should have pause for the purpose of considering just where it stands and whither it is bound. At the present time there are plenty of questions connected with the manufacture and use of motor cars, which are sufficiently open to furnish the vehicle for such an introspection. The SCIENTIFIC AMERICAN *has accordingly put seven of these questions to fifty manufacturing engineers prominent in America's automobile industry, and the article on this page embodies the editorial effort to digest the replies received, and to present the consensus of responsible opinion which they represent.*—THE EDITOR.

THE automobile industry, after just passing through a period of almost unbelievable prosperity, is now taking an inventory of itself—and of the future. New conditions have brought about new demands, which must be met if the industry is to forge ahead. Just what these conditions are and how the automotive industry purposes to meet them are matters of prime interest to automobile owner and non-owner alike, for the automobile of today is everybody's vehicle, playing a prominent rôle in the daily life of the entire community.

To begin with, automotive engineers are agreed that the passenger automobile has passed through its experimental stage and reached the period of comparative stability in performance and design. Great advances will still be made in many details, but until some new and revolutionary discovery or invention appears, it is generally believed that we may expect these developments to be along the lines already laid down.

On the other hand, the passenger car is only beginning to render to civilization the service which may confidently be expected of it within the next decade or two. Although there are already nearly eight million cars in use in America, the field of service ahead of us is almost limitless. The passenger car will, within the next few years, bring about a vast relief in the congestion of our large cities by permitting people of all classes to live in the country and use their cars in going to and from work. The motor car will be increasingly used in making farm life tolerable and more profitable, it will give extended service along the lines it is already rendering to salesmen and men whose work takes them far and wide about the city and country, and it will come to be an indispensable servant of the household as well as of the worker, so that we shall find many families which are now content with one car, using two or three.

So much for these optimistic views concerning the future of the passenger car, which have proved to be quite representative of the entire automobile fraternity. But how about our roads? It has already been said that in certain sections of our country, particularly in the Far West, a further increase in the number of automobiles must await more and better roads. It is quite obvious that good roads must precede the increased use of automobiles.

The Highways and Byways of the Nation

The consensus of opinion among automotive authorities is that since transportation is one of the most vital essentials of our daily life, all good roads movements should not in any way be discouraged. The United States has not done so well in the matter of good roads as might be hoped for, considering our wealth and natural resources and volume of automobile traffic as compared with other nations. Still, the good roads question is receiving careful attention at the hands of State and Federal authorities alike. Big educational campaigns are under way with telling results. Some automotive experts strongly urge a close cooperation between Federal road action and a local action. They also urge better trunk lines, so to speak, over good roads passing east and west to both coasts, and north and south from central locations on the two borders. At least one automobile engineer comes forth with the suggestion that we are at a period when double-tracked roads must be given serious thought, in order to permit two-way traffic at higher speeds than at present and with less danger of accident.

Of course, good roads mean everything to the automobile. Good roads mean more cars in use, better facilities to everyone in cities and rural districts alike, a lowering in the cost of living because of increased transportation facilities, and longer life and lower operating costs for all cars. Still, even automobile enthusiasts, while advocating better roads, caution against the expenditure of extremely large sums of State and Federal moneys alike, at a time when taxation is already a serious burden to business and individuals alike. Whatever moneys are available should be spent where they will do the most good.

And now we come to the matter of low-grade gasoline. Time was when gasoline could be bought at any gas station of such quality that it would rapidly evaporate if left standing in the open. But the heavy demands made upon the refiners have gradually lowered the quality of gasoline used by motorists, necessitating certain provisions in the design of most engines.

Meeting the Lower Grades of Gasoline

Automobile engineers have certainly faced the fuel problem unflinchingly, realizing that the problem was not only here to stay, but might become more acute as time goes on. Varied have been the ways to meet the fuel situation. For instance, the engineers of a leading automobile company invented a device known as the fuelizer, which was introduced in their car last spring. This device, by superheating a part of the flow of gas from the carburetor, insures almost perfect combustion of the fuel, making it possible to operate economically and efficiently any engine thus equipped, with the present lower grades of gasoline.

Other engineers have met the fuel problem through improvement in the design of the combustion chamber and intake manifold. Others are experimenting with exhaust heat with the idea of utilizing this heat to vaporize lower grade fuels and in this way increase the overall fuel economy of their cars. Electric vaporizers are being installed in certain cars for the purpose of facilitating starting in cold weather, with present-day fuels. Still another idea which is being applied is to give each part of the intake manifold a special curve, so that gasoline does not collect in odd corners, get into the crankcase, and cause loss of power in general. Hot spots and vaporizing elbows are being introduced by other engineers. Certain it is that carburetor manufacturers have assisted in these improvements in every way possible, for the good of the industry at large.

It appears that the engineers of the air-cooled type of car have been less affected by low-grade fuels than many other cars where the jacket loss is greater and where there is less heat efficiency inside the cylinders. This is due to the operating temperature of the air-cooled car. Yet these engineers, not content with their initial advantage, have worked on a baffle-plate heater on the intake manifold to break up the heavier contents of present-day fuel by throwing them by centrifugal force against heated plates where the heat serves to break up much of the fuel which would otherwise be lost.

Truly, all these improvements have done much to increase the mileage of the present cars despite the lowered quality of the fuel. Many of the medium-weight cars are making better than twenty miles on a gallon, according to the claims of their designers. Starting in cold weather has been facilitated by some of the improvements mentioned.

Just what is ahead of us in the matter of fuel is difficult to determine. Several automotive engineers hasten to assure us that we have met the lowest grade fuels which will ever be utilized for automotive purposes, while others—a very small number, to be sure—are equally emphatic in predicting kerosene, alcohol, and even crude oil. Still, the truth of the matter is that there is little to be gained in the use of still lower grades of fuel in passenger car engines. As was pointed out by the Secretary of the Petroleum Association in 1919, the demand for kerosene was such that there could not be much greater demand or the price would be equal to that of gasoline. It was the opinion of that authority that the supply of gasoline would keep pace with the demand. Almost daily new sources of oil are being discovered, which, together with new methods of refining and distilling the gasoline, should keep up the supply.

Still, it is best to be prepared, and certain automobile engineers assure us that as soon as problems affecting the distribution of other fuels besides gasoline have been solved, it will be possible, with the knowledge already in hand, to devise engines which will be entirely satisfactory with almost any fuels.

There is no indication of any wide variation from the present standard designs of gasoline engines. The problems which have limited the use of steam and electricity seem as far from solution as ever, and while it is always possible that there will be some revolutionary discovery, there is no reason to expect one. The steam and electric types have had years in which to "make good," so to speak, and apparently have failed to compete successfully with gasoline cars except in a very small and limited way. Still, they may possibly gain ground in the near future, but if they do they will find the gasoline cars also gaining ground, since the perfection of the gasoline engine and the automobile in general is by no means realized today. All in all, we are assured that the gasoline automobile is here to stay—in our day, at least.

A Word From Body Designers

It is generally believed among the automobile fraternity that the bodies have reached the point where there should be few changes in design. There will, of course, always be freak bodies and undoubtedly occasional changes in design. But since the automobile has become a factor of high economic value instead of a mere pleasure vehicle, there is no excuse for needless or faddish changes which seriously reduce the re-sale value of cars of previous models in the hands of buyers. As one body designer has put it, automobile body design is a compromise between service, practicability and appearance; but above all the bodies must be useful and practical and sufficiently strong to give service and a certain amount of protection.

The closed bodies seem to become more and more popular. Indeed, with the constantly increasing change from touring cars with the top down to the steady use of these cars with the top up, certain designers believe that the next radical change in automobile bodies will be a touring car with a permanent top which will be somewhere between the present-day type of sedan and the so-called winter top bodies. At any rate, the main object at present is to make the body as light as possible, consistent with safety and comfort of the passengers.

The matter of weight is an all-important one in present-day motoring, for the ever-increasing cost of fuel has to be compensated to some degree, and more efficient engine design cannot do it alone. Light weight is the better part of the solution. Hence one hears much about the many new alloys which are finding their way into automobile engines and other components. What is the status of this phase?

One engineer tells us that experiments are continually being made with new steel alloys and aluminum compounds; and there are indications that it will be possible shortly to reduce the weight of the cars to some extent. The application of these new materials, however, will be made in detail, and is not likely to be revolutionary at any one point. Still, manufacturers are using more alloy steel each year. Aluminum, on the other hand, is not being used to the extent of several years ago, by most builders. In fact, there is a strong block of automotive opinion which holds that aluminum is rather at a standstill than advancing as the metal for making parts for motor cars. Many engineers complain that it is too expensive. On the other hand, there are some who claim that aluminum is ideal. One engineer informs us that his company have been using considerable amounts of aluminum sheets and castings for some time, and are gradually increasing the use of this metal. So the engineering opinions as concern aluminum are pretty much divided. For bodies, however, aluminum appears to be considered with much

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The Trend of Specialization

What It Does for the Modern Professional Man, and What It Takes from Him

By W. E. Vogelback, Vocational Engineer

THE study of industry is a study of organization. After many years of systematic grouping and arrangement of activities we find business emerging in the last decade as one of the major professions subdivided into a multitude of minor professions Each of these minor professions, such as advertising, credit, management and salesmanship, has become a highly specialized science. Other major professions, particularly engineering, have followed this same trend of specialization. A century ago a man in any branch of the engineering profession was identified simply as an engineer. Fifty years ago he was a civil or mechanical or electrical engineer, while today these latter terms give but a vague idea of his qualifications or his occupation. Specialization finds its way into all industries and professions, subdividing single occupations into many, and confining the individual more and more to specific tasks.

There is an evil here to the detriment of the individual as well as to the profession. As it is, the world needs men of vision—men who are capable of big things—men who are scientists. Comparatively few men are scientists in the broader application of this term Few men are possessed of the ability to analyze complete problems; to see the relation between the problem in its entirety, and any or all of its component factors The individual minds of the great majority work synthetically. They grasp only that particular phase of a problem which comes under their immediate observation, one factor at a time without regard for the relation of that factor to the sum total.

Specialization does not assist in turning out these scientists—these leaders of men, but, on the contrary, materially assists in their suppression, and hence we must look elsewhere for the forces which tend to preserve this balance.

These forces will be found in our educational institutions, and our professional societies Here, stringent requirements should be fulfilled and ethical standards should be maintained But of these two, the greater responsibility rests upon our educational institutions

In the short space of the usual college course today it *is not expected that colleges* will *turn out men fully* equipped for their professional practice The aim should rather be to inculcate a method of logical reasoning; to turn out *analytical* thinkers—scientists But I feel sure that you will agree with me, that too many men just out of college come better equipped with a collection of facts than with methods of analysis In other words, we are turning out *synthetical* thinkers —men whose measure of comprehension of a subject is the quantity of facts they possess. I desire to emphasize this distinction between analytical and synthetical thinkers. Every individual belongs to one or the other of these classes The class of synthetical thinkers comprises the rank and file, the detail workers, the narrow specialists. The class of analytical thinkers comprises the executives, the leaders, the planners, men of vision and foresight

The degree of our analysis of any subject depends upon the interest we have in it. And our interest will depend upon our comprehension of the subject as a whole. If we reflect back upon these subjects in which we were most proficient in school, we will find that they were the ones in which we had the greatest interest. And probably we all recall our attitudes toward those subjects which we then seemingly knew we would never have occasion to put to practical use

Take our large cities, centers of industry with their vast day and night educational opportunities Would it not appear that the great majority of our successful men should be those brought up under these educational advantages? *And yet as we run through the* pages of "Who's Who" we observe in page after page the names of men whose education was acquired in the village school house, or small town college, or by home study. I believe these incidents are relevant and important, and that they are a natural result of a well-defined cause This cause is the greater ratio of practical learning to the degree of specialization In the smaller towns, industry is centralized and extensive *specialization is not expedient* Here the young man entering business sees the small shoe manufacturing industry or the rice industry in its entirety He sees the relation between the different departments and the whole plant With the whole mechanism under one roof, so to speak, his view is comprehensive This is impossible in the industries of our larger cities Here, specialization has reduced the work of the individual to a mere routine He fails to see the relation of his job to the industry. In time, perhaps, he will have held many jobs, but he will always be working under the disadvantage of lack of comprehension

After a man has completed his college training, the evil effects of specialization as applied to him, must be stemmed by the professional organizations Here by his association with other men in the same general profession, he extends his interests into broader fields Perhaps the most beneficial work that can be done by a professional society, is that of maintaining appropriate standards of ethics and qualifications for membership Here, too, is charged a large share of activity in securing appropriate license legislation. Limited preparation for the professions should be discouraged

The big problem of today is how are we going to keep the synthetical class from growing greater in proportion to the analytical class We see how specialization tends to confine more and more the individual to routine duties, to make of him a mere cog in the great wheel of industry The remedy calls for a greater interest in our undertakings The larger business *institutions have come to regard* this interest from the standpoint of the individual's partnership in the business They have evolved the medium of employes organizations and house organs for educational purposes In this way they have been able to maintain a partial balance between specialization and training

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Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

A Crossing Signal That Ought to Work

To the Editor of the SCIENTIFIC AMERICAN

Your last issue has just come to hand and the article "Automobile Signals for Danger Spots" *suggests a new* kind of automobile railroad signal It seems necessary to have a certain number of unguarded grade crossings —at least we have them with us whether it is necessary or not. As lighting laws require lights to be directed low, the signboards now in use are not always all that can be desired Any kind of automatic signal is open to the objection that it may get out of order and has to be maintained at a considerable expense—*except one kind.* This is a device familiar to all but never used as a signal. We are all familiar with the sound of running an automobile over a wooden bridge. The racket made by the loose boards could not possibly pass unnoticed. Here we have, then, a signal for railroad crossings which cannot be unheard except by the very deaf, which can be so made that even frost and snow will not make it inoperative, and which is so simple that it cannot get out of order. And if a device of this nature were worked on experimentally to *produce noise on purpose* there is no doubt but that a very characteristic sound could be produced which would soon become so well known that it would be a 100 per cent warning. I would suggest the use of boiler plate laid loosely on the proper support as found by experiment, with board fences on either side of the road to reflect the sound, as a perfect railroad crossing signal for all traffic, horse or motor, night and day.

Montchanin, Del. E. PAUL DU PONT

"Communication" Works Both Ways

To the Editor of the SCIENTIFIC AMERICAN:

During the past months I have read numerous articles in the SCIENTIFIC AMERICAN as well as in other esteemed journals concerning the hopes and possibilities of sending definite messages to Mars. There has been so much of this talk it would seem that some have seriously determined to make the effort Although there are many opinions as to the best method of sending the messages, etc, there are two points upon which all agree, namely, that the cost of the apparatus and power to convey the messages would be enormous, and secondly that the Martians, if any, must be far enough advanced in learning, as much or more so, *than ourselves, to notice or interpret* the messages sent, otherwise no trouble and expense would be warranted. This being admitted, why would it not be far more sensible, practical, and economical to assume that the Martians are sending messages to us, and to confine our efforts to catching their messages? If we are not clever enough to locate messages from them, *why go to the enormous and very doubtful expense of* trying to prove that they are our intellectual and scientific equals?

New York BAYARD S LITCHFIELD

A Question of Costs

To the Editor of the SCIENTIFIC AMERICAN

The current press articles purporting to give comparative costs for hauling freight by rail and motor transport seem to me unfair, misleading, and therefore harmful when and while they omit the cost, amortization and upkeep of improved roads used by motor transport. The community pays for such roads for the benefit of motor transport, while the railroads are required to provide their own rails and roadbeds.

No doubt the community derives benefit or profit from good roads and motor transportation, but until such advantages are reduced to a ton-mile basis with proper deductions for cost and maintenance of streets and highways, all such comparisons are, as before stated, unfair and harmful

O H. L WERNICKE

Gull Point, Fla.

The Rail Cycle

To the Editor of the SCIENTIFIC AMERICAN

In your issue of August 14th, page 160, just received, you show an invention by a Frenchman, for running a cycle on the railway lines. I may say that I have a drawing before me of which I worked out the details in 1888, and the answer from the Beeston Humber Company, England, dated November 16, 1889, states they could manufacture them for me. As the price *was more than I could afford* to spare in those days, I did not carry out the matter commercially A man named Hooley floated many companies later on, and some workman took, or copied, the drawing and made a crude lot in one of the branches, I think it was in Norway, later on an improved one was run by them or their late workman in Canada, and during the Boer War, *a better one was used by the British troops* They all stuck to my comparatively crude drawing, but none up to the present use the rubber tires, as I worked out Hand-propelled ones have been used on our railways for 35 years past, and now petrol motor ones supply their place Many gangers patroling the lines have been killed by trains coming upon them from behind, *because they could not* hear on account of the noise they make themselves My rubber tired ones obviate this trouble I have been a reader of your publications since 1870 or thereabouts

F MÜLLER

Adelaide, S A

The Detachable Broom Handle

To the Editor of the SCIENTIFIC AMERICAN:

On page 84 of the SCIENTIFIC AMERICAN, July 24, this year, is a notice of the detachable broom handle, and you say that the detachable broom handle is a brand new idea, and is taking This was the invention of the late Mr William Carver, of Adelaide, and was patented by him in Australia in 1896-7, and application was made for patent in England and America about the same time, and the writer found the money During 1897 the writer brought this broom handle under the notice of two or three manufacturers in England, and also sent it to a manufacturer in Berlin, but at that time nobody seemed disposed to make any alteration in their machinery. Since Mr Carver's death his widow has sold the patent to the Blind Asylum in Adelaide, South Australia, and these brooms are made locally by them My firm invariably purchases *the Carver detachable broom so that* the invention is not quite as new as your correspondent appears to imagine We think the late Mr Carver ought to have the credit And the writer would like his money back!

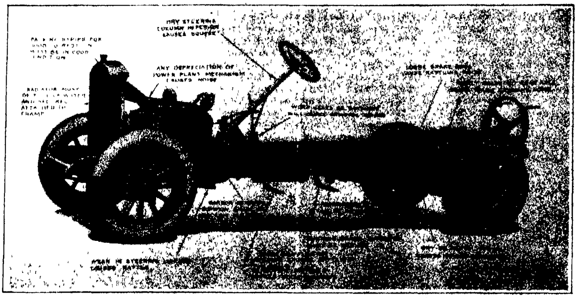
F H FAULDING.

Adelaide, S A

Where Is That Rattle?

The Commoner Automobile Noises, Their Causes, and How to Locate Them

By Victor W. Pagé, M.S.A.E.

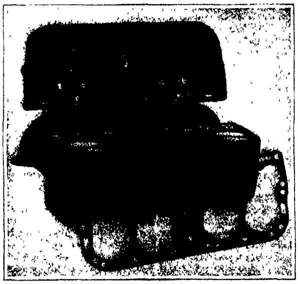


Side view of a typical eight-cylinder chassis showing points on the frame that may cause noise

THERE are many motorists who abhor a strange noise while their automobile is in operation and who cannot drive with any degree of comfort until the source of the offending sound is located and the cause eliminated. By far the larger number of motorists ride on blissfully unconscious of strange noises, and some apparently do not notice rattles, knocks or squeaks that may be plainly heard by the passer-by. Noisy action is not apt to materialize the first year that a car is put into service because almost anyone, until the novelty of possession wears off, will take the trouble to screw down the grease cups and give the chassis parts, not provided with other means of oiling, at least a perfunctory squirt or two with the common or garden variety of spring bottom hand oiler.

The car that has been operated for several seasons regardless of the care that has been taken of it, is apt to develop a number of noises when it is operated over highways that have even minor irregularities of surface. This results in the car running to the accompaniment of a number of rattles and squeaks that prove very annoying to those experienced motorists who desire a smooth-running and silent car. Some noises that seem to pressage serious troubles are due to chassis parts that are not very important and an operator may be caused considerable anxiety by a loud and constantly recurring noise that can be easily prevented by locating it and using a few drops of lubricant at the dry point.

The noises that are most common in the automobile mechanism may be grouped in four main classes. The most important of these are due to depreciation or other causes in the engine, then there are those caused by worn parts producing lost motion in the power transmission mechanism. A series of rattling noises are caused by wear in the running gear components and then there are a number of squeaks that result from looseness in the body and its auxiliary equipment.



The detachable head, now a feature of most engines, makes it easy to remove carbon from the engine interior and eliminate one fruitful source of noise

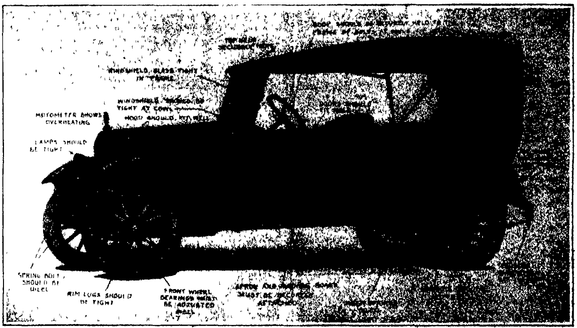
In attempting to locate noise the correct procedure is to inspect the car in a systematic manner and look over the various parts of the mechanism that are apt to be noisy in action if they are not properly adjusted and lubricated.

The power plant is the most common source of noisy action, but one can easily prove whether that member is at fault or some other part of the car by coasting down a moderately steep hill with the engine shut off and the clutch released. Obviously if the noise still persists it is safe to assume that it exists in the transmission system or in the chassis mechanism of the car. The most common engine noise is a dull thud or knock which is generally due to excessive carbon deposits or overheating when it is not caused by driving with a spark too far advanced or by worn bearings and other mechanical parts.

If the knocking is due to carbon deposits the only real remedy is to eliminate the cause. Most engines are now designed with cylinder heads that are readily detachable so the carbon may be easily scraped out of the combustion chamber interior as frequently as may be necessary. It is also possible to have a service station mechanic burn out the carbon by use of a combustion process employing a jet of oxygen. If the knocking noises are due to worn bearings at either end of the connecting rod or on the crankshaft main journals, it can only be remedied by taking up the lost motion existing at those points. In an engine that has been operated for some time cylinders may wear out of round or the pistons may change their form to such an extent that a dull knock known as "a piston slap" may take place. When an engine is worn to this point it usually calls for the services of skilled mechanics to restore it to full efficiency.

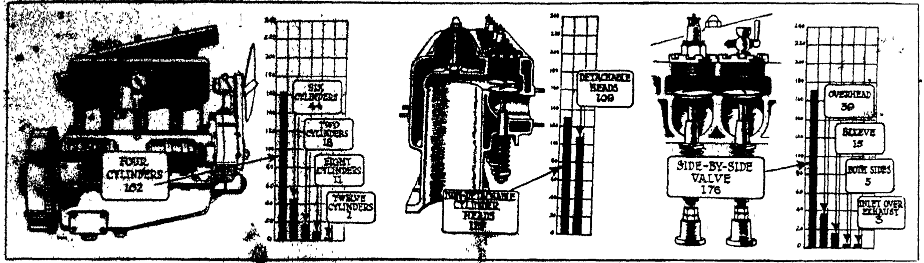
If the noisy action results from over-heating, it may be eliminated by remedying the cause of the excessive temperature rise. The first thing to do is to make sure that there is plenty of the proper grade of lubricating oil in the engine base and that this is of good quality. The next point to inspect is the oil circulation gage to make sure that the lubricant is being circulated through the engine. Among some of the common cooling system troubles that cause knocking may be mentioned insufficient supply of water in the radiator, loose fan belt, buckled hose connections that prevent the water from flowing properly, failure of the water pump drive or of the impeller element of the pump so that the water does not circulate around the water jackets; and in some of the newer cooling systems, functional failure of the thermostat used to regulate the engine temperature. Some of these thermostats are so connected to valves in the cooling system that when the engine is cold, the water is kept circulating only through the engine water jackets and practically none of it reaches the radiator. If the flow control valve becomes stuck in this position it will be apparent that the engine will over-heat even when the radiator is full of water. It is a very simple matter to remedy overheating caused by a loose fan driving belt, as simple, accessible adjustments are usually provided so it is but a few moment's work to adjust the fan belt to the proper degree of tension. A motometer, which is a compact specially devised form of thermometer adapted for installation on the automobile radiator cap is a valuable indicator for overheating troubles.

In most automobiles one is not apt to hear any noise from the transmission system when the car is driven in the high speed unless there is a large amount of depreciation in the bearings of the transmission gear or a poor adjustment of the bevel driving gears at the rear axle. When operating on intermediate or low gear ratios, most cars will produce noise even when the gearset is new, because of the large amount of power transmitted by the gears and the resonance of the hollow metal gear box which intensifies the grinding sound. The only way to reduce this noise to a minimum is to fill the gear case up to the proper level with special gear case lubricant that minimizes the noise by cush-


WINDSHIELD GLASS TIGHT IN FRAME
HOOD SHOULD FIT WELL
MOTOMETER SHOWS OVERHEATING
LAMPS SHOULD BE TIGHT
SPRING BOLTS SHOULD BE OILED
RIM LUGS SHOULD BE TIGHT
FRONT WHEEL BEARINGS MUST BE ADJUSTED

A few of the elusive noises that have nothing to do with the power plant or running gear are indicated in this diagram. If your car rattles or squeaks, inspect the items shown here as possible noise-makers

(Continued on page 15)



Graphic charts showing features of automobile engine design favored by European designers and car manufacturers

European Automobile Design for 1921

Where British and Continental Makers Follow and Where They Ignore American Practice

IT is not to be expected, after the experiences that European automobile designers have been through during the readjustment period still existing, that they would incorporate any radical changes on more than detail improvements in automobile design abroad. The year after the war a number of firms, in an attempt to attract attention to their product, evolved models with entirely new features, such as the three-cylinder air-cooled radial-engine power plant. Practically the only thing that may be considered radically new in current automobile engine design as far as Europe is concerned, is a new eight-cylinder English car in which all the cylinders are in line. This is an extremely costly car and will be made only in limited quantities.

One of the most noteworthy features in European design is the development of that class of car which is made necessary by the reduced purchasing power of the public. In Europe, the costs of running an automobile are very much higher than in this country, because of increased cost of fuel, parts, taxes and, in fact, everything for which the car owner has to pay.

There is great development noted in the types that may be called light cars and at the present time this term has been stretched quite beyond its original meaning. In former days a light car was one that did not weigh much in excess of a thousand pounds as a maximum. At the present writing, engineers designing cars weighing over a ton still designate them as light cars. Another thing that is strange to American car buyers is the fact that some of these light cars with small engines, which one would think should be very reasonable in price, cost considerably more than do some of the heavier cars in this country. The main attraction for the buyer of such a product lies in economy of operation because it is now understood that it is not only the item of first cost that determines automobiling satisfaction, but the maintenance or constant cost that obtains all the while the car is in use. As a rule, if a light car is well built it will sell for considerably more money than one expects it should, but this is made necessary because very high grade materials must be employed to secure lightness combined with strength.

It is interesting to note that foreign designers are now beginning to adopt American ideas that were not considered with much favor before the war. Owing to the present high cost of fuel and the scarcity of really skilled service-station labor, many European designers are considering those details of engine construction which make for economy. For this reason there is noted an increasing use of small two- and four-cylinder engines, while the larger engines having six, eight and twelve cylinders are becoming less numerous. Many of the light two-cylinder cars have air-cooled engines of the flat-twin or motorcycle V-engine type and it is claimed that these small power plants, which are rated as delivering from eight to ten horse-power, give real satisfactory service and are adequate for the uses to which they are applied.

The successful use of such small engines is made possible in Europe because the average European driver does not object to shifting gears as American car owners do. The object is not to see how many hills can be raced on the high gear or direct drive, as the European motorist has been taught that changing speed when occasion demands enables him to operate in a practical manner a small power plant that will provide a maximum number of miles traveling for the expenditure, and that will run more economically than the average American engine in similar cars because it is operated nearly all the time at that speed providing greater power output with minimum fuel.

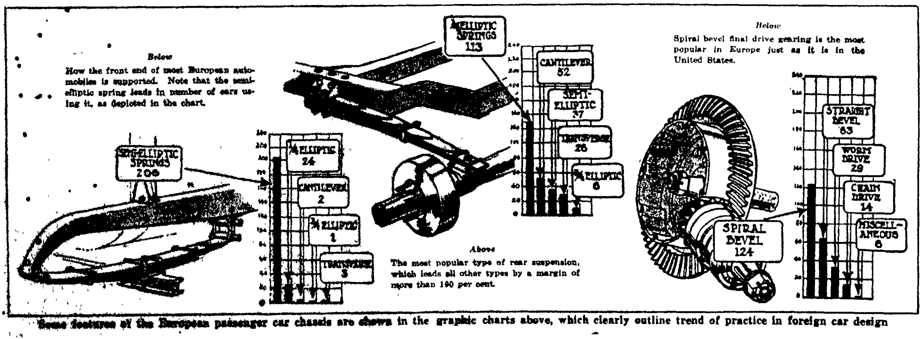
One of the points that was noted at previous European exhibitions was that European designers did not give the same attention to the accessibility of parts as American designers did. When detachable cylinder-heads were first used in the American engines, their adoption created considerable comment on the part of European engine builders who always favored the cylinder type having the heads cast integrally. During the past year a very large number of American cars using the detachable-head feature were put into service and their practical operation and the ease with which the engine interior could be reached for cleaning naturally impressed the foreign designers. A study of their designs shows that detachable cylinder-heads are being used in constantly augmenting numbers.

Another thing that the continental designers were slow to adopt was the use of asbestos friction material for clutch facings, especially on cone clutches, for which purpose leather was being used almost universally. At the present time one notes a growing appreciation of the use of asbestos fabric lining for cone clutches, these fabrics being composed of woven asbestos of a composition somewhat similar to brake linings.

Again, the foreign designers favored the four-speed gear-box for many years, and sometimes very small cars were equipped with change speed gearing of this character. But now, taking a lesson from American practice, we find that the three-speed gear is beginning to increase in number. Spiral-bevel rear-axle drive gears are also becoming more popular, while the straight-tooth bevel-gears have lost a considerable degree of the popularity they formerly enjoyed. This shows that the European motorist is becoming more particular and desires that quietness of action which is characteristic of most of the cheaper American cars just as much as it is of the higher priced product.

The European motorist who purchases cars consid-

(*Continued on page 19*)



Below

How the front end of most European automobiles is supported. Note that the semi-elliptic spring leads in number of cars using it, as depicted in the chart.

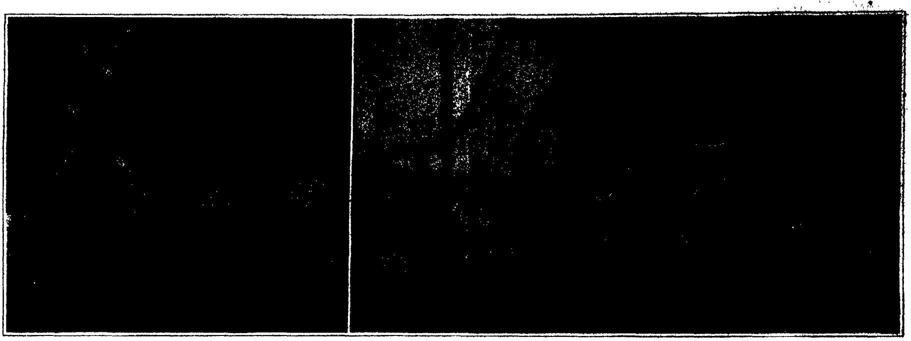
Above

The most popular type of rear suspension, which leads all other types by a margin of more than 190 per cent.

Below

Spiral bevel final drive gearing is the most popular in Europe just as it is in the United States.

Some features of the European passenger car chassis are shown in the graphic charts above, which clearly outline trend of practice in foreign car design



Left The three-arm protractor for locating the position of the vessel from angles observed with the sextant. *Right*: Deep-sea thermometer, bottom specimen cup and detachable sinker used in real deep-sea hydrography

Some of the apparatus used in mapping the bed of the ocean

Mapping the Waters Along Our Coasts

How the Hydrographic Surveyor Obtains Exact Information About the Sea Bottom

By Louis C. Kane

THE Coast and Geodetic Survey Steamer "Bache," a composite steamer of 472 tons, with a complement of eight wardroom officers and 45 enlisted men, has been working off the Delaware Breakwaters since May of last year, making a complete hydrographic survey of the approaches to Delaware Bay The Government's project includes a survey from the Delaware shore out to the 100-fathom curve, and from the light of Fenwick Island and the Light and Shoals vessel, to the entrance of New York Harbor After November, when weather conditions became such that little field work could be done, operations in the Delaware waters ceased until next April The "Bache" returns to the Breakwater anchorage every week-end, leaving for the working grounds just outside the Capes on Monday mornings

The "Bache" is fitted up with numerous scientific and navigating instruments Forward is the chart room where experts record daily soundings on charts, huge buoys, tackle and rope literally cover her deck, and below aft is a spacious room with office equipment where the ship's executive work is done Aft on the main deck is a winch engine, which handles the sounding line graded to fathoms and feet and so read by the leadsman An ordinary hand line with 12 pounds of lead is used for soundings up to 15 fathoms, and a 20- or 30-pound lead line for depths between 12 and 15 fathoms Above 25 fathoms an electric sounding machine is used. The lead is fastened to a traveler near the stern and runs forward by gravity to a point near the bow, where it is automatically released The leadsman reads the line when the ship has moved forward to the point where the lead was released This line is hauled in taut, straight up and down, and the depths ascertained Soundings are made with speed at five miles per hour

The "Bache" steams out to sea, picks out three stationary objects on shore for signals, and through a two-section angle instrument, figures out its position by trigonometry, each day resuming its work exactly where it left off the day before There is also on board a three-arm protractor or station pointer which graphically determines the ship's position at any time it is desired to know it.

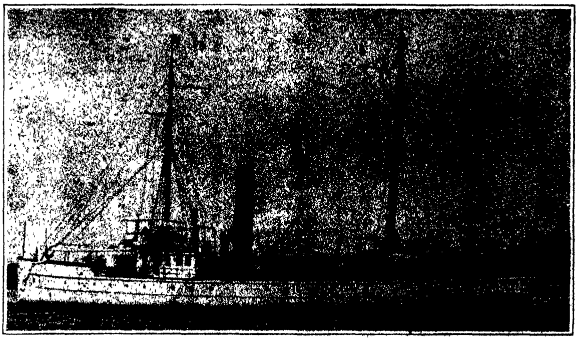
The shore signals can be observed for ten miles; beyond that limit, survey buoys are anchored for signals which are placed three miles apart and parallel with the shore line Using these buoy signals it is possible to continue the fixed position work a distance of about six miles beyond the limit of visibility of shore signals. The ship will then steam for miles in a straight line and as soundings are taken an instrument punctures on charts the depths of water. As the work progresses these charts show, out to 10 fathoms, parallel lines with a quarter-mile space between, which indicate the route surveyed. For the work beyond these buoys to the 100-fathom curve, the method used is what is known as precise dead reckoning. Currents are observed at intervals of two hours on this line and an average current applied to the compass course which gives the dead reckoning of the ship for a two-hour run The run to the 100-fathom curve and return is continued by these two-hour runs until the position of the ship can be accurately determined at the end line.

Soundings are reduced to mean sea level and finally placed on the charts of the coast. Unless taken at low water a little more water in a given locality will be found than the charts show

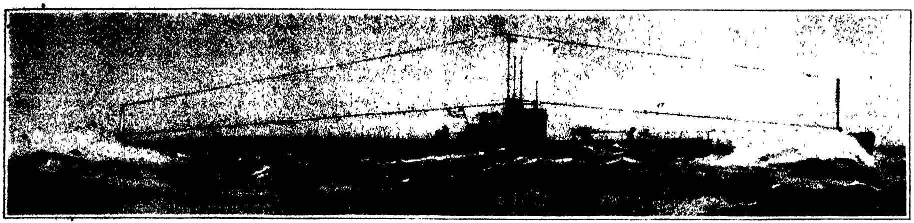
In explaining the work of the Coast and Geodetic Survey, Commander H A Seran of the "Bache" said:

"Our primary work is to cause an accurate survey and maps thereof to be made of the shore line of the United States. The work is along shore and inland, and consists principally in topographic and hydrographic surveys. Topographing surveying is merely the mapping of the land the same as you will see in any ordinary map Hydrographic surveys are simply surveys of the water To enable the mariner to avoid dangers and prevent his sailing on the beach, it is necessary to have maps of the water and numerous soundings. The hydrographic surveys of the Coast and Geodetic Survey have been carried out to such a degree of accuracy that it is easily possible for a mariner when making "land fall" to sound at intervals of about ten minutes, and in the course of an hour to be able to determine fairly accurately his position. The combination of a line of soundings and the radio direction finder make navivation much safer than was ever considered possible 35 years ago"

For deep sea hydrography the Sigsbee Deep Sea sounding machine is used, and instead of an ordinary hand line, piano wire is used. The weight consists of a cast-iron pear-shaped shot, with which is used a specimen cup for obtaining specimens of the bottom, and a deep sea thermometer for obtaining temperatures at the ocean bottom When the bottom is reached at, say, 3,000 fathoms, the cast-iron shot of 60 pounds is automatically released and the specimen cup with the thermometer alone brought to the surface. The thermometer is an ingeniously devised instrument, built to withstand the enormous pressures at the bottom and to record the minimum temperatures reached It consists of a framework, the thermometer itself inclosed by a metal jacket, and the whirling vane. Going down this vane is at the top. When bottom is reached and the upper pull commenced, the vane rotates, causing the thermometer to capsize; and the mercury column is broken. Upon coming to the surface in high water temperature the excess of expended mercury in the bulb is taken care of in a small reservoir. The minimum high temperature at the bottom is read by the length of the column of mercury left in the bore.



United States Coast Survey steamship "Bache"



Length 300 ft. *Displacement* at surface over 2,000 tons *Speed* 21 knots at surface, 11 knots submerged. Mounts one 5-inch gun

New United States Fleet Submarine

The Fleet Submarines for the United States Navy

THE Naval Appropriation Act of August 29, 1916, authorized the construction of a group of nine Fleet Submarines. Three of these have been constructed and bids for the other six are now under consideration. The accompanying official wash drawing gives an excellent idea of these vessels as they will appear when completed and at sea

The designs were prepared by the Navy Department and by taking the men shown upon the deck in this picture as a scale, it will be realized that they are very large craft for vessels of the submarine type The length overall is 300 feet, and their displacement, when traveling on the surface, will exceed 2,000 tons

The propelling machinery for surface operation consists of two main Diesel engines, each of 2,500 horse-power, located in the after part of the hull, driving directly on the main shafts, and two auxiliary Diesel engines, each of 1,000 horse-power, in the forward portion of the boat, driving electric generators which, in turn, supply electric current to two main electric motors, one on each main shaft When operating submerged, the vessel will be propelled by the two main electric motors, taking current from a powerful storage battery It is estimated that the maximum surface speed, under full power, will be 21 knots per hour, and that nearly half that speed will be attainable in submerged condition. The fuel oil capacity is such as to provide for a large radius of action, and the vessel will be entirely capable of accompanying the fleet under all conditions.

The armament includes torpedo tubes in the bow and stern, with an ample allowance of 21-inch torpedoes. There will be a 5-inch gun mounted on deck, forward of the conning tower

Three periscopes of the latest improved patterns will form a part of the equipment, and each vessel will be provided with the latest type of radio telegraph outfit, both for surface and submerged work, also with listening devices. Commodious and comfortable quarters have been provided for the officers and crew.

Particular attention has been given in the design of the structure of the vessel to insure adequate strength of the hull to resist the pressure due to deep submergence and to provide against rupture due to the explosion of depth charges.

Taking a Ship Through the Locks in Sections

EVERY so often a steamer whose length is greater than that of the lock chambers must be taken through the locks, in which event it becomes necessary to take the ship apart in order to get through. A case in point was that of the steamer "Canadian Runner," which was divided into two parts and brought all the way through from Port Arthur, Ontario, to Montreal. The Lachine Canal locks are not large enough to accommodate a steamer of the length of the "Canadian Runner," hence it was necessary to cut the rivets and divide the ship in two parts, the rear section being shown in the accompanying illustration. Once safely through the locks and at Montreal, the fore and aft sections were brought together in a drydock and riveted so as to complete the "Canadian Runner" To the layman this business of cutting a ship apart, bulkheading her so she will float, hauling the two parts separately for thousands of miles, and then patching them together again as good as ever, smacks of wizardry, but to the engineer it is all part of the day's work

Towing the aft section of the "Canadian Runner" into the drydock in order to couple it to the forward part and complete the steamer

The Singing Flame Employed as an Indicator for Explosive Mixtures of Gases

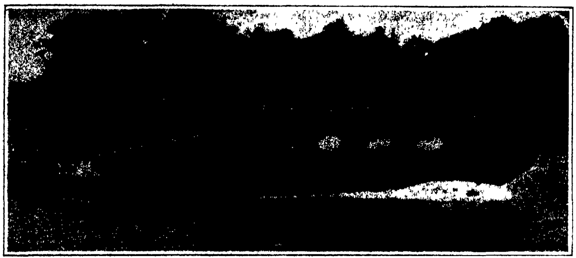
A GERMAN scientist, Professor Fleissner, has recently patented a new form of indicator for use in mines and other places, where explosive mixtures of gases are liable to occur. In the well-known safety lamp invented for miners by Sir Humphrey Davey, an excess of methane in the air is made known by the visible aureole which surrounds the flame, but in Professor Fleissner's device it is the more reliable sense of hearing which gives the warning His invention is based upon the well-known phenomenon of the so-called singing flame, sometimes known as the chemical harmonica.

Even school children nowadays are familiar with the fact that when a stream of gas is passed through a long, narrow tube and set fire to at its exit, the flame utters a definite musical note varying in strength and pitch according to the dimensions of the tube Professor Fleissner repeated this experiment, not only with ordinary illuminating gas, but with hydrogen and with acetylene, the latter gave a particularly powerful note and at the same time the flame flickered and jerked in a lively manner, whereas the singing flame produced by illuminating gas appears to burn quite quietly. By making the flame larger or smaller the tone produced can be made louder or fainter at will, and in accordance with this law the sound ceases entirely when the flame attains a certain size, but when an inflammable gas is allowed to enter the lower end of the tube whose upper end bears a silent flame, the latter is increased in size, and as a result of this the flame once more begins to sing, but as soon as this extra gas ceases to be supplied the sound naturally ceases

Taking a hint from this circumstance, Dr Fleissner arranged an apparatus with a flame just large enough to be silent when burning in ordinary air, but as soon as this device is carried into a chamber containing explosive gases, the flame at once becomes larger and promptly starts singing In place of the glass tube used in the ordinary experiment the inventor makes use of a hollow metal ball having two cylindrical necks, thus rendering it possible to give his apparatus the form of a mine lamp His device consists of a flame which can be regulated and which is surrounded by a glass cylinder which is inserted in the lower neck of the hollow ball, while the upper neck acts as a flue, both being surrounded with a wire basket The whole apparatus is mounted on a pole with a handle When it is to be used the burner is first arranged so that a tone is produced and then is shifted so that the tone ceases; as soon as any new explosive gases reach the lower end of the glass cylinder the sound at once recommences. The note produced may be interrupted when the lamp is removed from the point where it began to sing and in this manner a *quantitative measurement* of the amount of explosive gases present may be made, since, of course, the nature of the sound depends upon the quantity of explosive gases present —By *M Tevis*

Something Different in Speed Boats

FROM Germany comes the accompanying photograph of a new speed boat which is claimed to be the last word in such craft The boat is built like a whale, we are informed, and when running at high speeds it glides over the water with ease The power plant is reported to be a 200-horse-power engine Aside from the odd cabin of this speed boat, there does not appear to be any radically new principle involved



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A German speed boat with a queer shaped cabin, which has been attracting attention in Germany

The Heavens in January, 1921

The Dimensions of Our Stellar Universe as Revealed in the Milky Way

By Professor Henry Norris Russell, Ph.D.

TWO months ago we spoke of the researches of Professor Kapteyn and his assistants upon the relative numbers of stars of different degrees of real brightness. We may now return to another side of these investigations—which would have been presented last month, had it not been for the loss of a manuscript in the mails, and the substitution of one written on a different topic.

If we know the distribution of the stars among the relative degrees of brightness, both as they *appear* to us in the sky and as they really *are*, we may use this knowledge to solve a still more interesting problem—that of the manner in which the stars are distributed in space.

To see how this may be done, let us suppose that space is sown everywhere equally thick with stars, and is transparent, with nothing in it to absorb or weaken light, *even during a journey of many thousands of years*, and let us consider first the stars of some fixed degree of real brightness—say those equal to the sun. Such a star would appear to our eyes as a star of the second magnitude if its distance were nine light-years, of the third magnitude at 14 light-years, of the fourth at 23 light-years, of the fifth at 36 light years, and so on, each instance being 59 per cent greater than the last. If a star (of the sort considered) appears to us to be between the second and third magnitudes, its distance must be between nine and fourteen light-years—that is, it must be within a certain hollow shell of space, bounded by concentric spheres of these radii. A star which seems to our eyes to be between the third and fourth magnitudes must be within a larger hollow shell enclosing the first, of inner radius 14 and outer radius 23 light years—and so on. Now a very *simple calculation shows that the volume* of space contained within each of these successive hollow shells is almost exactly four times as great as that contained within the preceding shell, which lies just inside it. Hence, if the stars are scattered uniformly in space, we should get *four times as many of them* in the larger shell. That is, there should be four times as many stars which appear to us to be between the third and fourth magnitudes, as there are stars between the second and third magnitudes—and so on indefinitely, *the number of stars increasing four-fold, in geometric progression, for every step of one magnitude fainter*.

For stars of some different real brightness—say 100 times as bright as the sun—the limiting distances would differ, being ten times as great in this particular case suggested. But the *proportional* distances for different magnitudes would be unaltered and the final proposition, italicized above, would still hold true. Hence it must be true for a mixture of stars of all degrees of brightness, so long as this mixture of stars is scattered uniformly throughout the whole of space.

Hypothesis and Fact

If, however, the remoter regions of space are more thinly peopled with stars than those which lie near us, the proposition will no longer be true. The larger shells, within which must lie the stars which look faint to our eyes, will contain fewer stars in proportion to their volume, and the ratio of the number of stars of one magnitude to that of the number of stars of the next brighter magnitude will no longer be exactly four, but will fall off more and more as we come to the fainter and more distant stars.

Now this last situation is what we actually find in the heavens. Among the very brightest stars, which are conspicuous to the eye, the ratio of increase from one magnitude to the next is indeed nearly equal to four. But when we get down to the tenth magnitude it drops to about three, and for the 17th magnitude, the faintest so far studied, it has fallen to only a little above two.

This shows conclusively that the more distant regions of space, within which the majority of these faint stars lie, must be much more thinly filled with stars than the regions near the sun. Other interesting conclusions follow: for example, we know that among the twenty stars which appear brightest to us, the majority are objects of very great luminosity, exceeding the sun by more than a hundredfold. But it would not be safe to conclude that half of the stars of the fifteenth magnitude were really a hundred times as bright as the sun; for the exceedingly remote parts of space in which stars would have to be in order to appear to us so faint, are almost empty; and we get far fewer such objects, in proportion, among the stars of the fifteenth magnitude, than among those of the first.

Measuring Our Universe

Knowing the relative numbers of different degrees of luminosity, it becomes a soluble—though hardly a simple—problem to figure out just how the density of distribution of stars in space must fall off at increasing distances, in order to account for the observed numbers of faint stars. It is in this way that Kapteyn has reached his results. As might have been expected, he has discussed different parts of the sky separately—there are many more faint stars in proportion to bright ones in the Milky Way than in other regions of the sky; and this indicates that the distance to which we would have to travel in order to reach a region in which the stars are thinly scattered must be much greater in the direction of the Galaxy than in that toward the galactic pole.

In the latter direction, Kapteyn finds that at a distance of 690 light-years from the central plane of the Galaxy, there are only half as many stars in the same volume of space as there are in the central plane itself. At 1800 light-years the star-density is reduced to one-tenth of the maximum; at 4000 light-years to one one-hundredth; at 7500 light-years to one one-thousandth. In the plane of the Milky Way, taking a sort of general average for different directions, we would have to go some 2300 light-years to get the density down to one-half the maximum; 9000 light-years to reduce it to a tenth; 28,000 to bring it down to one one-hundredth, and about 55,000 light-years to find a region where the density would be one one-thousandth, and the stars ten times as far apart, on the average, as they are near the sun.

At 11 o'clock. Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock. Feb. 21.

At 9½ o'clock: Jan. 29.

NIGHT SKY: JANUARY AND FEBRUARY

These calculations exhibit the Milky Way as a huge flattened cluster of stars, thickest at the center and thinning out gradually. The denser parts are included within a region some 3,500 light-years in thickness, and perhaps 16,000 in diameter; but stragglers are found within a region five times as thick and ten times as broad.

The conclusions regarding the thickness of this flattened cluster are based on a definite discussion of the available material, and represent the best knowledge at present to be attained. The values given for the diameter are, however, preliminary, and will in time be replaced by those resulting from a more exhaustive study, which will take some time longer to complete, and will take account of the possibility—indeed probability—that the Milky Way extends to different distances in different directions. In their present state, however, these inquiries mark a notable advance in our knowledge of the universe of stars, and certainly cannot fail to give us a lively sense of the tremendous magnitude of that universe.

The Heavens

The winter constellations are now full in the south. Orion is high on the meridian, with Canis Major below on the left, Taurus above on the right, Gemini above on the left, Canis Minor below this, and Auriga, highest of all, right overhead. Far down on the southern horizon observers south of Virginia may see the brilliant Canopus—next to Sirius in brightness among the stars.

Leo is well up in the east, and Hydra has half risen in the southeast. Ursa Major is conspicuous in the northeast, while Draco and Ursa Minor are low in the north, and Cepheus and Cassiopeia sinking in the northwest. Perseus, Andromeda and Aries are in the west, and Eridanus and Cetus in the southwest.

The Planets

Mercury is in conjunction with the sun on the 16th and is practically invisible. Venus is very conspicuous as an evening star, and sets about 8.30 P. M. in the middle of the month.

Mars is an evening star, close to Venus. On the evening of the 8th he is in conjunction with the latter and only half a degree away. Uranus at the same time is but a quarter of a degree north of Mars. So close a conjunction of three planets at once is unusual enough to be interesting, even though one of them is invisible to the naked eye.

Jupiter is in the eastern part of Leo, and rises at about 9.30 P. M. in the middle of the month. Saturn is five or six degrees farther east, and just over the border of Virgo. He is a very interesting telescopic object just now, for his rings are turned almost edgewise toward the earth and sun. During this month indeed we see the dark side of the rings, illuminated very faintly by sunlight which filters through between the free particles of which they are all composed, and as well by light reflected from the planet.

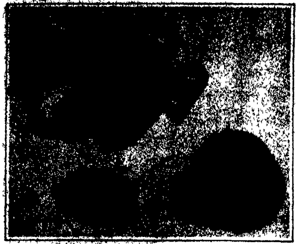
Uranus is an evening star, close to Venus and Mars; while Neptune is in Cancer, observable only with tele-[illegible]

[illegible] is new at 12.27 A. M. on the 9th, in her first quarter at 1.31 A. M. on the 17th, full at 6.08 P. M. on the 23rd, and in her last quarter at 8.02 P. M. on the 30th. She is nearest the earth on the 23rd, and farthest away on the 9th. During the month she passes near Mercury on the 8th, Uranus on the 12th, Venus and Mars on the 13th, Neptune on the 24th, Jupiter on the 26th, and Saturn on the 27th.

Skjellerup's Comet

Telegraphic announcement has just been received of the discovery of a faint telescopic comet by Skjellerup—at what observatory is not stated—on December 13th. The comet was then in R. A. 6h. [illegible],

(Continued on page 30)



A loud-speaking 'phone that strikes out over new ground

New Style of Amplifying Telephone of Simple Construction

A NEW type of loud-speaking telephone, claimed to have better speaking qualities and of simpler construction than other types, has recently been placed on the market by a New York electrical engineer. The illustration above shows the several parts of the new instrument.

The advantages of the instrument are obtained through what the inventor terms a "mechanical amplifier." A very intense magnetic field is used in the receiver and instead of using the speaking diaphragm as an armature, a small cube of soft iron is used and this is attached to a lever, one end of which attaches to the center of the diaphragm. The lever magnifies the motion of the armature, so that a very small movement produces the large amplitude of vibration necessary for a loud-speaking telephone.

The intense magnetic field is obtained through the use of two horse-shoe magnets, each of which is magnetised so that it will pick up three and a half pounds of iron.

These magnets are clamped together in a non-magnetic frame and between the ends of the poles is clamped a laminated soft-iron core, which forms the core for the speaking coil.

The sensitive transmitter is of the typical carbon-button construction, but the diaphragm is very large. The back carbon of the button is adjustable so that any desired density can be obtained in the carbon granules and the sensitivity of the instrument can be varied at will.

This set is used at one end of an ordinary telephone circuit and no amplifiers are needed. The loud-speaker can be adjusted so that it can be heard at a distance of 200 feet in the open and the transmitter is sensitive to ordinary speech up to distances of from 40 to 50 feet.

It is claimed that once the instruments are installed and adjusted to meet local conditions they need no more attention than an ordinary telephone instrument and can be depended on for service year in and year out.

The inventor has also devised a switching box to be placed on the desk of the factory executive or other user of the telephone and by pressing a button he is at once placed in touch with any one of his department heads, who need not leave their work to answer him. The use of the loud-speaker for actual conversation rather than mere calling is a decided novelty.

The fact that the diaphragm itself is not used as an armature on the loud-speaker makes it possible to use a mica diaphragm. This, it is claimed, does away with much of the "metallic" sound so common in other types of loud-speaking phones.

Sheet-Iron Boots Used by Coal Miners of Germany

IF there's one man in the world who needs water-proof boots more than the next one, it is the man who has to dig in land that is partly water. Our illustration shows such a worker—a coal miner in one of the German fields, whom the more or less poetic soul of the caption-writer has credited with a share in the payment of Germany's war indemnity. We doubt this—we have a feeling that the gentleman of the picture is interested solely in the origin of his next meal and his night's lodging. Whatever his immediate motive for labor, however, he has simply got to have footwear that will keep the water out; and if there is no rubber to be had he must improvise something in its place. This he has done with the aid of sheet-metal and solder, and we have little doubt that his extraordinary boots will outlast those of more conventional manufacture.

German miner keeping his feet dry in the absence of rubber

A New Turret Tool Post

A VERMONT manufacturer has recently developed a turret tool post which has the advantages of rigidity, ease of operation as well as adaptability through its compactness for use on lathes. The center height of this new device above tool rest may be as low as 1⅜ inches.

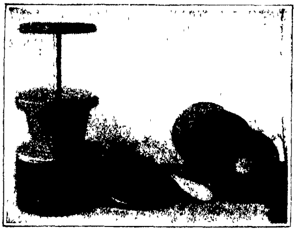
The turning and facing cutters are adjustable for height as they become worn by use and grinding. Thus the cutting edge may be kept on center without sacrificing the strength and rigidity as is done in ordinary tool posts. By one movement of the binding lever the operator releases, accurately indexes to the next tool position and again rigidly clamps the turret to its base. The turret rings are interchangeable on any base.

Turret tool post of unusual flexibility that holds the tool rigid

An Extra Passenger in the Side-Car

THIS folding side-car seat makes it possible to take an extra passenger along with you in an ordinary side-car. The weight of the child is taken off the car rider's lap, thus making the trip more enjoyable for both. When the seat is folded beneath the cowl it serves to hold parcels, automatically bringing the lower cross-bar into position for use as a sturdy foot rest. It slides to either side leaving a ten-inch space in the car for a suit-case alongside, still affording room beneath the seat for the rear riders' feet. When folded it is completely off the floor space and out of the way. It is light, durable, detachable, adaptable to any side-car and low-priced, and accommodates an adult or a child in substantial comfort, although it is of course primarily designed for occupancy by a child.

A side-car seat for the baby that folds away when not in use



"Evaporometer" of the U. S. Forest Service

Measuring Evaporation

IF you live on a mountainside and desire to study climatic conditions—the effects of evaporation on crops and trees—an instrument designed by C. G. Bates of the United States Forest Service should render helpful guidance. Invented to measure the rate of evaporation in the National Forests, which may vary widely from day to day as influenced by wind, sunshine and temperature, the apparatus is of consequence in the summer months when the warm wind blows down the side of the mountain. Frequently severe injury to trees results from the intensity of the vapors originating in evaporation and carried by these warm winds.

Described as an "evaporometer," the device is only 7 inches high, weighs one pound, and is of an indestructible nature—usable in winter as well as summer. However, the rate of evaporation in the National forests during the winter months is insignificant. When the winds of summer beat against the hilly slopes, evaporation is an important factor, causing severe injury to trees. This damage is apparent in the spring of the year when the foliage takes on a brownish hue.

The instrument is simple in its principle of operation. A wick is fed by water from a small, seamless tank, which is so arranged in position as to be always exposed to the effects of wind and sun. The apparatus, according to claims, is less cumbersome and more precise in its determinations than the tanks of water formerly used by the United States Weather Bureau at the forest observation stations. The photograph shows the "evaporometer" in use in Saline County, Nebraska, the instrument being under a makeshift shelter. The apparatus is used only at night and during rains.—By *S. R. Winters*

Protecting Iron with Cadmium

SINCE cadmium belongs to the same group of metals as zinc, it is natural that inventors should have made the effort to substitute it for the latter metal in the process of galvanizing iron. Recent endeavors along this line have met with success, according to M. Grès of the French Bureau of Inventions, who states in the official *Bulletin des Inventions* that cadmium is less alterable either by moist air, by acids, or by salt water than zinc. Although cadmium itself is comparatively high priced, it can be applied with good results in such a very thin layer, about 35 grams per square meter, that the process is not at all costly. The coating of cadmium adheres very closely to the other metal and the cadmium is sufficiently plastic for the pieces of iron thus protected to be either stamped or bent without destroying the protective layer. If anything, the showing here is better than that of zinc.

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Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

One swimming teacher to a dozen novices in the art

An Overhead Trolley for the Swimming Pool

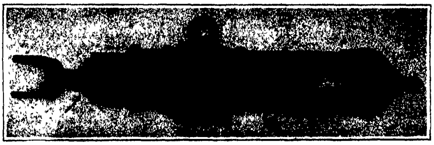
THOSE of us whose shrinking dispositions prevented us from learning the gentle art of swimming from the other "fellers" under natural surroundings, and who were later called upon to acquire it in the swimming tank of high-school, club or college, will recall the cross between a trolley pole and a fishing rod at the end of which we made our first venture But this apparatus is rather tough on the instructor who has to hold down the land end of it, and it is open to the objection that only one student can have the attention of the said instructor at a time A Cincinnati school has met this situation in a highly ingenious way by the installation of a circular track above its tank, on which the trolleys supporting the aquatic novices run The single instructor can range freely about the edge of the pool, paying attention to a large group of beginners at once and accomplishing the same result in a fraction of the time formerly required At the same time, the old puzzle of whether the learner was really propelling himself through the water or being dragged by the instructor is disposed of for keeps.

A Shock Absorber That Is Different

THE first feature to be observed in the construction of this absorber—called an air spring by its makers—is the simplicity The spring consists of one working part, and is absolutely air controlled instead of oil controlled as other types of air springs.

The only purpose for which the oil has to serve in this spring is to form a seal to hold the air. There is no dependence upon the passage nor transmission of oil or air from one chamber to the other in order to get action of the spring. There are instead two separate and distinct chambers, one above and one below the piston head, so that both the downfall and recoil of a shock are absorbed on air cushions

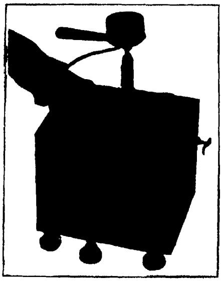
When installing these springs on a car it is not necessary to shape nor form-cut the steel springs The sliding member of the front air spring is milled to conform to the full width of the steel spring, and made fast by a pin through the sliding member and through the eye of the main leaf of the steel spring. In the rear air spring there is a ball and shackle The shackle is made to conform to the full width of the steel spring and drilled to conform to the size of the eye in the main leaf of the steel spring, and the original pin that now attaches the frame to the steel spring is used in making the shackle attachment. The ball rests in a socket in the sliding member of the air spring which absorbs all play required by action of the steel spring or difference in the elevation of the two sides of the car, thereby relieving the frame and steel spring from all severe strain—*By C W. Geiger*



A shock absorber that works with air alone

A Volt-Meter for Tight Places

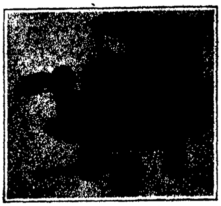
IT is not always easy to make the physical application of a volt-meter to a battery—especially a battery that is in a more or less awkward place on an automobile Either we have an entirely rigid instrument in which the dial of the meter is itself an obstruction and prevents our getting down between the binding bars of the battery as we would like, or else we have an apparatus that presents a vast amount of wire to tangle us up An interesting effort to compromise between these two extremes is illustrated herewith The contacts are joined to the dial member of the meter by wire, all right enough; but it is a single wire for both contacts, and there is an altogether convenient little handle by means of which the latter are manipulated. It is difficult to imagine a battery so inaccessibly located that it could not be reached and its voltage tested by this instrument.



Handy volt-meter of novel design

The Smooth and Silent Wrecking Truck

THE clatter of the iron-bound wrecking truck is no more for an Indiana manufacturer has placed a new rubber-tired machine on the market. The 8 inch solid rubber tires fit wheels which are 16 inches in diameter. The wheels are equipped with roller bearings The axle does not revolve but is permanently fastened to the frame of the truck. This arrangement gives additional strength and rigidity to the machine. The long bearing in the frame supports the saddle post and this overcomes a tendency to keel and prevents smashing the truck when going over roads which are extremely rough. The saddle post is adjustable and the saddle will fit any part of the front or rear axle A clamp secures the device to the front axle and the spider shape of the saddle with its supporting arms makes a perfect support for the differential of a rear axle—By *Allen P. Child.*



Moving the crippled car without rousing the whole neighborhood

Some Economic Results of Draining the Zuider Zee

THE draining of the Zuider Zee upon which preliminary work has begun, is causing great concern among the fishermen and others who will be deprived of the employment to which most of them have devoted their entire lives, and who must engage in occupations to which they are complete strangers, unless they can live upon the compensation that is expected to be granted by the National Government of Holland for the loss they will suffer.

Besides fishermen and others deprived of employment many thousands of people will be directly or indirectly affected in their earnings or their property. This class includes practically the entire population living near the Zuider Zee, and numbering, it is estimated, about half a million people. Besides the fishermen who will suffer, thousands of persons engaged in selling, curing, transporting, and otherwise dealing with fish will be affected, while buildings and other property used in the fish trade will much depreciate in value.

Attempts have been made to estimate the direct annual damage which will result to the affected classes, and it is placed at 3,000,000 florins ($1,206,000) at the least. The probable indirect loss has not so far been estimated.

A commission representing the National Government is visiting the affected districts and studying the conditions there with a view to rendering a report upon which compensation for the loss may be based. It is not supposed that indirect losses will be covered, but that, as a rule, people, like the fishermen, whose means of livelihood will be entirely destroyed, will receive annual sums sufficient to keep them from want, the amounts to be graded according to the earning ability of the injured party—that is to say, the older he is the greater the compensation. No definite sums have yet been proposed, but suggestions of amounts equivalent to $5 or $6 a week have met with dissatisfied protests.

The work of draining and filling the Zuider Zee cannot be entirely completed for 15 or 20 years, but loss will begin much sooner, with the first interruption to the pursuits of a fishing village.

Grippers for the Battery

BATTERY men very frequently find it hard to remove the element of a battery by ordinary means. These grippers that have been designed especially for this purpose will do the work in a jiffy. A platform of sufficient size is provided upon which the operator stands with the battery secured to a pipe standard, by means of two small adjusting clips. When the grippers are applied the element soon comes out. The old method was to hold a battery between the feet and use most any tool handy. It is a time and labor saver.—By *K. H. Hamilton.*

A sure-fire outfit for removing the battery element

The Trend of Design for 1921

(Continued from page 5)

provided at the middle of the chassis, and contains a leather cup-packed piston, the space behind which is filled with oil. The piston is actuated by a short rod that extends to the brake pedal. Oil-distributing lines of flexible metallic tubing extend to the individual brake-cylinders on the rear wheels and also to corresponding members on the front wheels. It will be apparent that if pressure is applied to the brake pedal oil will be forced through the pipe lines to the four individual braking cylinders and the brake-band sectors will be spread apart with great force. It is stated that the hydraulic system eliminates practically all brake rods except that connecting the master plunger with the brake pedal.

The pressed steel frame has not changed in design for several years, with the exception that in most cars it has been made deeper at the center section, which has made it possible to dispense with running-board supporting-irons On the sporting types of automobiles that are now so popular, the running boards are replaced with short steps no wider than the entrance doors While the semi-elliptic spring still remains the most popular form for front suspension, a number of makers are adopting the simple quarter elliptic or cantilever spring for front suspension and the full cantilever spring for rear suspension. Disk wheels are being used in increasing numbers and they are apparently used on all varieties of cars in preference to wood or wire spoke forms wherever a real stylish design is desired The metal disk wheels are strong and give the appearance of even greater strength and are much easier to keep clean than the spoke forms They hide much of the car mechanism that is ordinarily exposed with the spoke form of wheel and give the impression of greater simplicity of chassis assembly.

Many refinements of detail are noticed in designs of bodies and especially in the interior finish and appointments of closed bodies The sedan type is deservedly popular because it is an all-the-year form of car which provides maximum comfort for the passengers in either summer or winter and is best adapted for the rapidly changing weather conditions of the intermediate seasons In designing bodies of all types the builders have endeavored to secure seating arrangements that will provide maximum comfort for the passengers. There has been no change in such standardised details as steering gears, change-speed, clutch and brake-control systems or the front-axle and steering knuckle construction because these have evidently been developed to a point of practical perfection beyond which it is difficult to go. A general tendency toward making lighter cars is noted and all the various refinements that make for more economical operation are incorporated in those cars designed by engineers who keep in touch with the public demand and who endeavor to cater to its needs.

Automotive Milestones

(Continued from page 6)

favor, because it reduces weight most appreciably.

Aside from the use of special steels and aluminum, many engineers have found it possible to reduce weight by the simplification of certain parts and the elimination of non-essential parts. In some instances road shocks are being taken up by flexibility rather than by rigid construction, and this practice serves to keep the weight down consistent with road safety.

The Matter of Tires

Despite numerous attempts to replace the pneumatic tire, with its attendant troubles and high cost and limited life, it still holds the field. Its supremacy is absolute. Practically all automotive engineers are agreed that there is no reason to believe that a substitute for pneumatic tires is in sight. And they are also agreed that all substitutes so far brought to their attention during a period of fifteen years, are questionable. Automobile engineers have nothing but praise for the tire builders, who have steadily kept on improving their product so that many of the former shortcomings of the pneumatic tire have been overcome, particularly in the *cord tire* Some engineers believe that much can be done in the way of better spring suspension for taking some of the work off the present-day tires; but the majority seem to feel that the pneumatic tire is the logical means of taking up road shocks The tire problem is solved to their satisfaction. if the motorist only uses the proper sizes for his car and sees to it that they are kept inflated at the proper pressure, he should have little or no trouble.

Vibration has always been an inevitable feature of the gasoline automobile, especially at low speed Still, just as noise has been steadily reduced until the present-day cars of the better kind purr along with no more fuss than the electrics, so are the engineers planning to reduce vibration. In the heavier engines vibration has already been reduced to a minimum, largely through the multiplying of cylinders but also through the use of lighter reciprocating parts and careful balancing.

Assuming that the motor is designed correctly with all parts well balanced and such parts as crank shaft especially being sufficiently stiff, there still remains what is commonly known as torsional vibrations which occur at various speeds of the motor The question of eliminating this vibration is successfully met, however, by some makers through the *employment of a device attached to the* crank-shaft. Some engineers are convinced that vibration can be diminished to almost imperceptible proportions, but others are not so sure of this One engineer in particular directs our attention to the fact that there is little chance of eliminating any great amount of this vibration except by the use of six-throw or multiples of six crank-shafts, since theoretically the four throw crank-shafts used in four- and eight cylinder engines cannot be balanced Much is being done through the use of aluminum and composition pistons and connecting rods and other reciprocating parts Vibration, for most engineers, continues to be more or less of a problem which must be more or less solved, according to the present status of their engines

In conclusion, it is believed that the advances in automobile design in the next few years will be along the lines of still greater lightness and greater economy in operation These will probably be made at some sacrifice of power and speed acceleration In Europe, however, there are now many cars on the market giving economies of around 40 miles to the gallon of gasoline and develop 12 to 15 horse-power It is probable that as fast as the demand for these light and cheap running cars appears in the United States, the American automotive industry will be able to meet it with engines having fewer disadvantages than the European types.

Where Is That Rattle?

(Continued from page 8)

ioning the gear teeth and at the same time that prevents the gear case from vibrating fast enough to produce a musical, or rather one should say unmusical, sound.

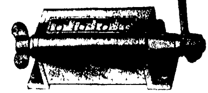
A point in the transmission system that produces a rattling noise every time the clutch is engaged or the speed of the car varied suddenly by the accelerator is the universal joint The reason that this produces noise is that the lost motion between the parts is taken up on the first application of power and the joint is rea-

(Continued on page 17)

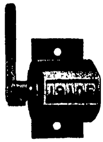
The Starting-Point for Low Prices

Do you know what your machine operative can do to cheapen the cost of your product—by putting it through in *less time*? What he'll gain in speed you'll save in wages, when his "pep" and production is automatically checked-up by a

Veeder
COUNTER



The large Set-Back Revolution Counter at right is ½ actual size. The small Revolution Counter below is shown nearly full size



The Set-Back Revolution Counter above records the output of the larger machines where the revolution of a shaft registers an operation Counts one for each revolution, and sets back to zero from any figure by turning knob once round Supplied with from four to ten figure-wheels, according to purpose Price, with four figures, as illustrated, $10 00 (subject to discount)

The Small Revolution Counter at left records the output of smaller machines where a shaft-revolution indicates an operation Though small, this counter is very durable, its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines Will subtract if run backward. Price, $2 00

Every machine where a reduced labor-cost is possible can have its Veeder counter. Let us send you the Veeder booklet, counters there for all purposes, see what it offers for yours

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- Allegheny Steel Company of
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- Libby, McNeill & Libby,
Selina, Cal.

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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

HOSE GUARD.—S. A. WOODRUFF, 500 Central Bldg., Seattle, Wash. Among the objects of the invention is to provide a guard which can be quickly applied to the leg or ankle and inserted within the shoe at the heel portion so as to protect the hose from a brush or cloth which is used in polishing the shoes. A further object is to provide a device which can be manufactured at a reasonably low price.

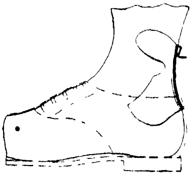


DIAGRAM SHOWING THE POSITION OF THE DEVICE

Pertaining to Aviation

SAFETY DEVICE FOR AIRCRAFT.—G. AIELLO, 1 W. 84th St., New York, N. Y. Among the objects of the invention are to prevent the fatal fall of an airplane due to any cause whatever, and particularly nose dives while landing by a device acting automatically through a control of an emergency webbed surface or auxiliary wing to cause the airplane to raise its nose and lower its tail to the ground and stop within a short distance, giving the airplane the properties possessed by birds.

PROPELLER.—F. FOLEY, Gillette, Ark. This invention has for its object to provide a device of the character specified especially adapted for use in flying machines, wherein the propeller has a blade of spiral form so arranged that the pitch of the blade may be varied. The propeller is composed of similar sections, each section being approximately a half circle.

Electrical Devices

OSCILLATOR FOR ELECTRIC FANS.—M. M. GIASSER, 446 King St., Charleston, S. C. This invention has for its object to provide mechanism of the character specified for use especially in connection with ceiling fans, having mechanism for oscillating the motor casing causing the blast from the fan to swing through a fixed arc for continuously changing the direction of this arc, thus greatly broadening the scope of the fan.

PROCESS FOR TREATING MINERAL OILS.—W. JOHNSON, 520½ S. Ervor St., Dallas, Texas. This invention relates to an apparatus and process for cracking crude or mineral oil. Another object of the invention is to provide a device including a pair of spaced electrodes for superheating the vapor on its passage from the vaporizing tank to the condenser to effect "cracking" to a high degree.

FUSE.—P. A. RICCIO, 4547 Park Ave., New York, N. Y. The aim of this invention is to provide a device which may primarily be handled by absolutely inexperienced operators without any danger of the fingers being burned upon the insertion of such fuse into the conventional clips. A further object is to provide a fuse which incorporates construction eliminating the necessity for fuse switches, in that the fuse itself incorporates a switch feed.

FOOT OPERATED SWITCH.—J. C. ROUNDBACK, 2232 3rd Ave., New York, N. Y. The invention relates to an alarm system for jewelry merchants and other storekeepers when a store is "held up." The object is to provide a form of switch which may be conveniently and unnoticeably operated by a person at any point in the rear of the counter, even though such person's hands may be held above his head, a slight pressure of the body creating a closing of the circuit and the sounding of the alarm at any desired point.

Of Interest to Farmers

GAITING STRAP.—M. P. MCCARTHY, c/o F. W. Murphy, Poughkeepsie, N. Y. The invention is more particularly to harness parts known as gaiting straps used in training horses. Primarily it is the object of the invention to provide means for facilitating the breaking and training of young horses to handle themselves properly in the shafts of the trotting sulky, and to provide means for restraining the horse from side movements or lateral trotting movements.

COTTON SEED CUTTER.—W. R. PINCKNEY, 5805 W. Yon St., Little Rock, Ark. This invention relates to an appliance for cutting cotton seeds and the like for the purpose of grading and testing the same in order to determine the quality and market value of the seed. The object is to provide a device by which twenty-five seeds can be opened at one operation and the meats exposed for examination, thus shortening the time required for the grading of the seeds by one half.

INCUBATOR.—J. B. GLOVER, Mattoon, Ill. The object of the invention is to provide mechanism in connection with incubators for providing uniform heat for the eggs, together with means for regulating the same to prevent overheating. The incubator is well ventilated and there is provided a continual circulation of water. All the joints of the heater are on the top where they are easily accessible for repair, and where in the case of leakage there will be no dripping on the eggs.

CREAM REMOVER.—J. H. COURNYER, Oskaloosa, Iowa. The invention has for its object to provide a siphon cream remover, comprising intake and outlet tubes, a cup detachably connected with the intake tube, having an internal groove, said cup constraining the cream to flow into the cup from above, a cleaning plunger movable through the intake tube, the bottom of the cup being spaced far enough below the bottom of the intake to receive the plunger and permit the entrance of cream when the plunger is in lowermost position.

Of General Interest

POURING SPOUT.—H. L. STRONGSON, 147 W. Broadway, New York, N. Y. The invention relates more particularly to a device which may be applied to a sealed tin or applied to any form of can which contains liquids to be decanted for the purpose of pouring the liquid from the can through a specially prepared spout and kept covered by a closure cap. An object is to provide the pouring spout with a cutting blade so that it may be quickly inserted in the can and clamped thereto.

COLORED DESIGN AND PROCESS OF PRODUCING THE SAME.—B. D. DONER, c/o Huron College, Huron, S. Dak. An object of the invention is to provide a process by means of which articles such as jewelry, signs, articles having decorative borders, etc., may be provided with colored designs without the use of paints, pigments, enamels, or any other means of coloring in which the color is actually applied to the design. A further object is to provide designs in which color is obtained by diffraction.

CAMERA ATTACHMENT.—E. PIRRI, 147 Bleecker St., New York, N. Y. It is the object of this invention to provide means for operating a lens shutter and igniting the flash light powder, used for lighting the subject simultaneously by means of electricity. The attachment for this purpose including an actuator and a switch with contact points, said contact points being in circuit with a spark producing element, whereby upon the actuator being operated the circuit will be closed and a spark produced.

ALLOY.—F. MILLIKEN, 55 John St., New York, N. Y. The object of the invention is to provide an alloy especially designed as a special acid resisting metal at high temperatures and also as a high temperature metal. The alloy contains the following metals in substantially the following proportions: Copper 50-60 per cent, nickel 28-36 per cent, zinc 4-8 per cent, iron 4-8 per cent.

ALLOY.—F. MILLIKEN, 55 John St., New York, N. Y. The invention has for its object to provide an alloy especially designed for the manufacture of hose connections, valves, and fittings, particularly such as are used in handling gasoline and lighter distillates of petroleum. Another object is to provide an alloy not liable to cut or "wire draw." The alloy consists of the following metals. Lead 10-14 per cent, copper 55-65 per cent, nickel 6-11 per cent, and zinc 14-18 per cent.

ALLOY.—F. MILLIKEN, 55 John St., New York, N. Y. The object is to produce an alloy more especially designed as a high temperature metal capable of being manufactured into bolts, fittings and other articles subjected to high temperatures. Another object is to provide an alloy capable of withstanding the corrosive action of boiling concentrated or dilute sulfuric acid. The alloy will also resist tartaric and citric acids. This alloy consists of the following: Iron 16-20 per cent, chromium 5-7 per cent, copper 31-38 per cent, nickel 38-46 per cent, manganese ¼-¾ per cent.

HAIR CURLER.—A. V. P. MARTIN, 944 Gravesend Ave., Brooklyn, N. Y. This invention has for its object to provide an improved hair curler formed of a comparatively stiff, open frame and arranged to enable the user to readily curl a strand of hair around one of the members of the curler and then securely fasten the curled strand in position. Another object is to enable the user to readily open or close the curler without danger of its parts becoming entangled in the hair, or the hair breaking in the operation. The device is so constructed that it is simple and durable, and may be formed either as a hair curler or weaver, or as a "barette."

PASTE DISPENSING DEVICE.—S. L. HARWOOD, Uniontown, Ala. The invention relates to paste dispensing device which will receive any ordinary paste tube of proper size and thread and which can be operated to eject the paste in the desired quantity. The device is primarily intended for tooth paste, shaving soap, and similar material, and will economise material in that it will insure an almost complete emptying of the tube, at the same time protecting the tube.

EYE SHIELD FOR AUTOMOBILE DRIVERS.—J. F. KEITZ, 908 Summit Ave., Jersey City, N. J. An object of the invention is to provide eye shields so supported as to be out of the normal or straight-ahead line of vision and so arranged that a slight movement of the head will serve to bring the eye shields into the oblique lines of vision and thereby be disposed between the eyes of the wearer and the lights of an automobile facing in the opposite direction. A further object is to provide means whereby the right and left shields may be varied to suit the wearer's eyes.

PROCESS AND COMPOSITION FOR THE PROTECTION OF MONETARY AND OTHER DOCUMENTS.—D. N. CARVALHO, 17 W. 10th St., New York, N. Y. The invention relates to means for the protection of negotiable and other papers, and has reference to a substance which may be rubbed over the writing and after such treatment it will be impossible for said writing to be erased or fraudulently changed in any way without permanent injury to the writing. The composition is translucent so that the writing may be seen just as distinctly as before treated.

TOOTHBRUSH.—MATILDA MUELLER, c/o Louis Fitsing, R. R. No. 2, Walkerton, Ont., Canada. The object of the invention is to provide a toothbrush having separate brush backs with bristles thereon so disposed as to be positioned for simultaneously cleaning a row of teeth at a side surface and crown surface, the brush being adapted to be rocked about the general longitudinal axis thereof to position the brush for cleaning the inner or outer side of the teeth with the crown.

COMBINATION KEY.—F. CLARK, address R. A. Day & Co., Apt. 91 Bis, Mexico City, Mexico. This invention relates to a key particularly adapted for use in combination with a lock which may be set to correspond with the setting of the combination key. Another object is to provide a construction in which the various wards are of substantially the same construction, there being provided an adjusting means whereby the relative effective functioning parts may be readily and conveniently varied and adjusted throughout a wide range of settings.

SNAP FOR BRACELETS.—W. MAGUIRE and A. BAUSCH, address Albert Bausch, 100 Maiden Lane, New York, N. Y. Among the objects of the invention is to provide a snap fastener for flexible bracelets in which interlocking hooks are provided having overhanging members whereby the hooks must pass each other and then come back to a locked position, thus assuring a positive interlocking action which will remain closed under any and all conditions except the usual opening action.

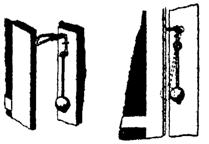
BUILDING CONSTRUCTION.—C. J. ASCHAUER, 224 Citizens Title and Trust Bldg., Decatur, Ill. The general object of the invention is to provide a method of building substantially fireproof residences at no increased cost over the ordinary methods of construction and in which pre-cast wall block units are employed and constitute mold elements for reinforced run-in-place posts and beams, making it possible to build a reinforced, concrete skeleton type of construction without the use of wood forms.

HAIRPIN.—L. H. KNICKEL, 300 S. Grand St., Monroe, La. The invention has for its object to provide a hairpin which is simple in construction and convenient to use, and which when engaging with the hair will be held against accidental displacement, the pin having a positive lock for firmly gripping the hair to hold the pin in place, and wherein the head of the pin may be of ornamental construction.

KNOCKDOWN CRATE OR BOX.—J. L. WERNER, 407 S. Clinton St., Chicago, Ill. An object of the invention is to provide a collapsible crate, which can be set up or folded easily, and which will occupy but small space when folded, having sides and a partition which may be swung parallel to the top and bottom when the crate is folded and which not only perform their obvious functions when the crate is set up but also maintains the same in its set up or operative position.

Hardware and Tools

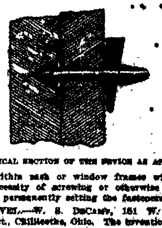
DOOR CHECK.—McG. E. TATE and R. M. TATE, Somerset, Ky. Among the objects of this invention is to provide a cheap and simple door check consisting of a minimum of working parts, yet effective in preventing the jar and noise occasioned by the slamming of a door. A further object is to provide a construction which is applicable to both right and left hand doors.



A PORTION OF A DOOR AND JAMB SHOWING CHECK AS APPLIED

PROCESS OF PRODUCING IRON AND STEEL BARS.—L. JONES, 928 Wheeling Ave., Muncie, Ind. An object of the invention is to provide a process by means of which bar iron and steel may be produced from machine shop turnings, and by means of which a more homogeneous product is effected, and one in which the chemical composition is substantially uniform throughout, with greater tensile strength. The reclaiming of turnings and minute scrap being assembled cold by this process eliminate the expensive busheling and great loss in heating of these small particles, the solid pile resulting in a more uniform and highly fibrous bar.

STORM WINDOW FASTENER.—C. B. SIBLEY, 9 City Hall Sq., Lynn, Mass. The invention relates generally to sash fasteners, and more particularly to storm windows, the object being to provide a simple arrangement whereby storm windows and the like may be readily and quickly fastened, and securely held within sash or window frames without the necessity of screwing or otherwise more or less permanently setting the fasteners.



A VERTICAL SECTION OF THE DEVICE AS APPLIED

SHOVEL.—W. S. DECAMP, 151 W. Mulberry St., Chillicothe, Ohio. The invention has for its object to provide a shovel with means for registering the strokes, controlled by the

(Continued on page [illegible])

Where Is That Rattle?

(Continued from page 15)

sonably quiet until there is fluctuation in the power application under which condition the worn parts rattle to some extent and produce noise. A very annoying squeaking noise that is heard sometimes when the clutch is released is due to an insufficiently lubricated clutch spigot-bearing or a dry or worn-out bearing used in the clutch throw-out. Sometimes rollers are used to bear against the clutch throw-out collar and on one very popular make of car, if lubrication of these rollers is neglected, they will rattle and squeak in a very irritating manner.

If the trouble in the gear box is due to depreciation of the bearings on either the main shaft or the lay shaft, one will notice a certain amount of rattling all the while the car is operated. Anti-friction bearings of either the ball or roller type, if one of the rolling elements is broken or if an inner or outer bearing race ring is cracked, will produce a constantly recurring noise which can be best identified as a "clicking" sound. A flaked ball or roller causes an intermittent clicking noise and particles of metal, such as broken gear tooth edges resulting from careless gear shifting, may cause a distinctly annoying and hard-to-locate click which occurs only at intermittent intervals when the pieces pass between the gears. A poor adjustment of the driving gears in the rear axle is indicated by a grinding noise and this may be the result of the gears meshing too deeply or not meshing deeply enough. The only remedy for a noisy rear axle is to keep the gears properly adjusted and to be sure they are in good condition and also to keep an ample supply of grease in the differential housing.

By far the greater number of automobile noises are due to the automobile chassis or body. Any looseness in the multiplicity of links and shackles will cause rattling noises. In making an inspection it is well to start at the front of the car. The first thing to do is to make sure that the license tag and the lamps and lamp-supporting brackets are secure. A lamp glass or lens which is loose in the door frame will make a rattling noise all the time the car is running Packing material in the form of candle wicking or strips of felt may be placed between the lamp glass and its metal frame to prevent this movement. The radiator retention bolts should be checked over to make sure that the radiator is firmly held. Examine the mud-guard supporting irons and also the points where these are attached to the frame. When the cooling fan runs on plain bearings it is important to lubricate these frequently because an annoying squeak will be noticed if they are dry The looseness of any of the main components of the car relative to the frame, such as engine, transmission case or body, will result in a pronounced noise, though this will be of an intermittent character and only noticed when the car is run over rough roads. The front wheels should be checked over to see that they are properly adjusted and any looseness in the various link joints of the steering mechanism will cause rattling.

One of the most common causes of a squeaking noise is a dry spring. The spring leaves should move freely one over the other all the while that the vehicle is in use, and it will be evident that any rust or lack of oil between the springs that will interfere with this free movement will produce noise because of the friction of the dry metal parts. The motorist who lubricates his springs properly removes one of the main causes of squeaking in an automobile and also maintains the easy riding qualities of the car. The spring shackles and the shackle bolts will wear and cause noise. These are points that are very often neglected because those at the rear end of the front spring and at the front end of the rear spring are usually inaccessible and apt to be neglected by the motorist. When running on rough roads the car frame and load is continually shifted by being thrown upward whenever the wheels go over a bump or down into a hollow and as this motion is transmitted to the worn shackles noise is apparent.

A number of creaking and squeaking sounds are produced by looseness of various members of the body or its auxiliary parts and most of this noise is caused by two pieces rubbing together which should be in fixed relation to each other When the car is assembled at the factory it is the custom to interpose felt strips or leather pieces between the frame side members and the bottom of the body sills After the car is in operation for a time these packing materials bed down and the body will rub on such parts of the metal frame that the flattened padding permits it to come into contact with. When the retaining bolts that hold the body to the frame are loose a slight movement of the body is permitted whenever the car goes around a curve or whenever it is operated over bumpy roads. Even though the degree of motion is slight, it is all that is needed to produce a squeaking or creaking that can be readily distinguished Squeaks are also caused by poorly fitting doors and in a closed body, rattling and squeaking may be the result of window sashes which do not fit the window frames accurately. Sometimes a door will become loose in the body side member and will rattle because it does not fit the frame properly. Noise resulting from this cause may be remedied by using packing strips or small pads of rubber or other material that will fill the space between the frame and the door when the door is closed

Even the windshield may produce a creaking sound and this usually happens because the nuts on the supporting posts have become loose under the cowl. Other body parts that can cause intermittent noise are the mud-guards, the running-boards and side aprons On some moderate priced and all cheap cars, the metal of which the fenders and aprons are made is of light gage In order to economize on supporting brackets the makers of these cars do not support the thin sheet metal any more than is necessary to have in stay in place on the car. The unsupported metal produces a constant drumming or rattling noise because it acts as a diaphragm which vibrates in synchronism with the engine at certain critical speeds This noise can be prevented by reinforcing the thin metal with strips of wood or metal riveted or bolted to the offending section and attaching the end to frame members or on supporting brackets.

If the top is not held securely at the front end of the car where it is attached to ball ends on the windshield supporting posts a rattling or knocking noise will be evident Wing nuts are generally used at this point and when these are tightened only with the fingers a slight loosening takes place that will soon produce noise If they are tightened with a wrench or pliers, one is reasonably sure that they will not loosen. An engine bonnet or hood that does not fit well will cause both rattling and squeaking sounds. The hood side retention clamps should hold that member firmly in position and strips of rawhide or textile packing should be placed between the hood and the ledges on the radiator and the cowl of the body on which the hood rests. Most cars are now provided with material of this nature, which is threaded back and forth through a series of holes in the supporting ledges If for any reason the laces should break or become flattened out so that the metal parts would come in contact it is a relatively simple matter to install a new piece.

Sometimes the glass of the windshield becomes loose in the frame and will move slightly all the time the car is running.

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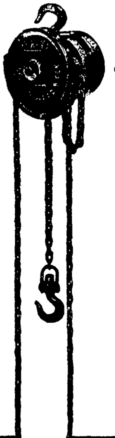

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RECENTLY PATENTED INVENTIONS

(*Continued from page 16*)

lifting of the loaded shovel. The shovel having a scoop and a handle, a counter carried by the handle, a trigger associated with the handle rod operatively connected with the counter for actuating the same, a spring holding the rod at one limit of its movement, and a lug on the trigger having an inclined surface engaging the free end of the rod

LOCK —V Zimmermann, address Julius Strauss, 100 W 31st St, New York, N Y The primary object of the invention is to provide a lock in which the latch is mounted normally free to be manipulated for opening and closing the door under ordinary conditions, and also to provide a key controlled bolt that is normally maintained inactive, but which may be released by the key and actuated by a manipulating means to active position, locking the door

PIPE WRENCH —J H Hall, R F D No 5, Rupert, Idaho The object of this invention is to provide a wrench especially adapted for grasping cylindrical objects, wherein handle members are pivotally connected and provided with gripping heads, the heads being normally spring pressed away from each other, one of the heads having a movable gripping jaw so mounted that it is moved inwardly in one direction, and outwardly by the other direction

TUBE CLEANER —F Zlatnik, P O Box, 835, Miami, Arizona The invention relates to tube cleaners in which there is a tubular *body to be thrust* into the tube and turned, this tubular body carrying scrapers mounted loosely and movable within certain limits for enabling them to adjust themselves to the irregularities of the inner surface of the tube, and means for providing hydraulic pressure for *forcing* the blades radially outward

RADIATOR STAND —A A Worsen, Brownsville, Pa The object of the invention is to provide a stand of the character specified adapted to be connected with a stand, work bench or the like for grasping and holding *a radiator in such position that every* part of the radiator is accessible, and which is capable of adjustment to bring every part *into position to be worked upon*

BAND SAW —M H McCormick, Benford Polk County, Texas The invention relates to saws for sawing lumber and other purposes, and has reference more particularly to a saw in which the band is reinforced at the gullet separating the saw teeth *An object is to* produce a simple and efficient band saw which can be inexpensively produced which will not *readily crack or otherwise deteriorate in use*, and which is capable of long and hard service

Heating and Lighting

TRAP —H W Justis, Napanoch, N Y The invention relates to a trap for water of *condensation in any steam system an object* being to provide means for automatically discharging the water when it reaches a predetermined level, *the operation being controlled* by the pressure of water upon a diaphragm causing the opening of a valve, and then auto*matically closing the valve when the level of* water falls to a predetermined point

Machines and Mechanical Devices

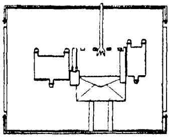
HOISTING MECHANISM —M L Senderling, 333 Fairmount Ave Jersey City N J *Among the principal objects* which the present invention has in view are to secure a rotative center in close proximity to the part to *be fitted, to increase the efficiency in the* power applied, to simplify the mechanism, to regulate the power in correspondence with the work *performed, and to reduce the height* of vehicle to facilitate the loading thereof

APPARATUS FOR WASHING CROCKERY, CUTLERY AND THE LIKE —A Kammermann, 12,020 Superior Ave, Cleveland Ohio The object of the invention is to provide a washing apparatus for use in hotels, restaurants and live places where various utensils have to be washed quickly and effectively, and which will preferably in addition deliver them in a dry state ready for use without it being necessary for any person to come in contact with the water

MACHINE FOR OPERATING ON WOOD STRIPS —G O P Kunicke, P. O. Box 385, Dunellen, N J This invention relates more particularly to a machine for performing certain operations on the wood strips entering into the pneumatics of player pianos The invention has for its object to provide a machine which will automatically groove the strips at the side edges to accommodate the material of the bellows, and puncture one of the strips to receive screws

CONVEYOR —D W Starkey, 5719 Race Ave., Chicago, Ill. An object of this invention is to provide a conveying device which may be run economically due to the fact that one or more buckets or carriers may be provided A further object is to provide a conveyor having means for removing material from a pile periodically as the conveyor passes the pile, the material being forced on to the carrier, and the carrier being provided with *wheels which are outside of the range of the* material

ATTACHMENT FOR PLATEN PRESSES —W W Coffee, 244 Washington St, Atlanta Ga The invention has for its object to provide an attachment especially adapted for use with platen presses equipped with Miller feeders for converting the press into an envelop press, the device *comprises a pair of* clips having lugs for engaging slits in the tympan to hold the clips in place said clips *being adapted to be spaced apart less than the* length of an envelop

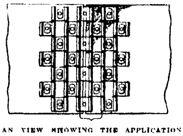


A PLAN VIEW OF PART OF PRESS SHOWING THE ATTACHMENT

CUTTING MACHINE —W C Waller, Wiggins, Miss This invention relates more particularly to machines designed for cutting potatoes, an object of the invention being to provide a construction and arrangement of rotary drums carrying radially projecting knives and coöperating with a fixed cutter blade having knives at its edges *for easily and quickly cutting* the potatoes or other articles into sections

VENDING MACHINE —W C Mack, Baker, Ore The invention relates more particularly to machines for vending liquids An object is to provide a device which may be actuated by coins of different sizes or denomination to deliver a predetermined amount of liquid A further object is to provide a device having means for varying the amounts delivered for a given coin, as for instance, when the price of the liquid rises or falls in accordance with the market quotations

ADJUSTABLE FLEXIBLE BELT FASTENER —J B McGrory, 46 Washington St., Norwich, Conn The invention relates to a fastener adapted to be arranged at the ends of a belt, whereby the ends may be readily connected and the belt shortened by cutting off the desired lengths, leaving a plurality of links secured on the belt and properly placed so that they form a plurality of rows to permit a pin to pass transversely of the belt through suitable eyelets carried by the links



A PLAN VIEW SHOWING THE APPLICATION OF THE FASTENER

PATTERN LATHE —F Nueske, 116 Walker St, New York, N Y. An object of the invention is to provide means for reciprocating a pattern and the work held in engagement respectively with a fixed pattern disk and a rotary cutter so that the work will be shaped by the cutter in accordance with the pattern A further object is to provide means for mounting the work and the pattern, and means for spring pressing a pattern against a fixed pattern disk and the work against a rotary cutter during their reciprocating movement

STAMPING MACHINE.—H Lasko, 710 E 14th St, New York, N Y The invention relates to a machine by means of which articles such as fountain pens may have imprinted on their outer surface the name of the purchaser or any other subject matter desired A further object is the provision of a machine which is not limited alone to stamping upon fountain pens, but is adaptable to other objects such as pencils of any size.

GAS ENERGY CONTROL HEAD FOR OIL WELLS —E V. Crowell, Box 611, Tulsa, Okla. The *object* of the invention is to provide mechanism for utilizing in the most efficient manner the gas energy in or present with oil, *by a more even distribution* of the use of the gas with respect to the volume of oil raised, and effecting a more even flow *of the oil, eliminating agitation* of the oil to a great extent

Musical Devices

REPRODUCER FOR TALKING MACHINES. —J W Kaufmann, 1780 N Monroe St., Baltimore, Md This invention has for its object to provide a connection between the needle and the diaphragm controlling lever which will eliminate the usual rigidity between these parts and which will intensify the movement of the needle during its transmission to the diaphragm.

Prime Movers and Their Accessories

SPARK PLUG.—A. A. Wells, 42 High St., E., Detroit, Mich The invention has reference more particularly to what are commonly termed spark plugs used in connection with the jump spark ignition system of internal combustion engines Primarily the object is to provide a spark plug in which the working parts may be removed from the engine cylinder independent of the outer shell for the purpose of cleaning the same, as well as to enable new parts to be inserted

INTERNAL COMBUSTION ENGINE.—B S Williams, 416 Deaderick St., Nashville, Tenn An object of the invention is to provide a valve actuating means for internal combustion *engines, the arrangement* of the rocker, valve and push rod being such that friction is materially reduced in operation, by virtue of *the provision of knife edges* and corresponding bearing sockets which contain oil

Railways and Their Accessories

RAILWAY TRACK CROSSING.—B. G. Van Dyke, Jr, 1193 Hamilton Blvd, Detroit, Mich *An object of the invention* is the provision of a crossing comprised of movable rail sections which are capable of occupying one *extreme position* in which they provide gaps to form a clearance for the wheel flanges of a car, and another extreme position in which *they provide an unbroken rail surface* for the passage of a wheel thereover without the incident jars and bumps which occur in crossings of the ordinary construction

STAKE POCKET FOR LOGGING CARS —A D. Adams, 2226 18th St, Gulfport, Miss This *invention has for its object* to provide a pocket especially adapted for receiving the stakes of logging cars wherein a channel-shaped pocket is provided, *having a keeper* permanently connected to one side of the pocket and detachably connected with the *other side and normally held* connected by releasable trip mechanism, capable of being operated simultaneously for all the stakes of *one side of the car, from the opposite side of* the car

Pertaining to Recreation

AMUSEMENT APPARATUS —C Hermann, address Eccentric Ferris Wheel Amusement Co, 456 E. 141st St, New York, N Y The primary object of the invention is to provide a ferris wheel which embodies some of the features of a gravity railway The invention provides a wheel on which some of the passenger carriages are adapted to revolve around the axis of the wheel in fixed position at predetermined intervals around the circumference of the wheel, and other carriages adapted to travel by gravity through a defined irregular path of movement

TOY ROCKER CARRIAGE.—F. Humphreyville, *Chester Inn, Atlantic City, N J.* This invention relates to wheel toys and has particular reference to a toy which may be used *by children either as a carriage or as a* rocker. The frame and rockers of the device when used as a carriage are raised from the *ground, and are supported by wheels* which are adjustable

DOLL WALKING DEVICE —G H Williamson, 1211 W 103rd St., Chicago, Ill. An object of the invention is to provide a device by means of which a doll may be supported and the feet caused to reciprocate in a manner which closely simulates walking. A further object is to provide a device which will support the doll in an upright position when left standing

Pertaining to Vehicles

AUTOMOBILE LOCK —C. Gransn, address Thos E. Shea, Woolworth Bldg., New York, N. Y *An object of the invention is to provide* an automobile lock which will lock the foot pedals of an automobile in an extreme position so that the clutch will be disengaged and the brake will be engaged. Another object is *to provide* a lock which will absolutely prevent the theft of an automobile provided with the device.

GEAR SHIFT.—*G. L. Brock*, West Point, Miss. The invention relates to gear shifts for general use but especially applicable to automobiles. The invention comprehends a tank for compressed air and a number of cylinders controllable by pressure of air supplied *from* the tank, together with means under control of the operator for distributing the air into the different cylinders, also indi*cating means controllable by air pressure* for disclosing to the operator the particular air cylinder which is in action.

FRICTION TRANSMISSION. — G. L. Jacques, Neillsville, Wis. The particular object of the invention is to provide a device with means to propel any vehicle and to provide transmission of *friction* mechanism from the motor to the drive wheels of the automobile truck, tractor *or* the like. A further object is to provide a means for reversing the drive, and altering the speed at will without the use *of* a clutch.

MUD GUARD —E. L. Tomlinson, North Branch, Mich. This invention relates to a mud guard adapted for use on Ford cars, an object is to provide a guard which acts as a shield to prevent the throw of mud against the radiator by the wheels. A further object is to provide a mud guard secured to the ordinary guards of the car and extending across the front of the car at the lower portion of the radiator

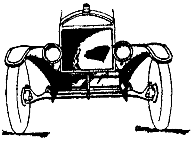


DIAGRAM SHOWING GUARD IN USE

SHOCK ABSORBER —H Smith and L. Le R Carpenter, Amoret, Mo. This invention has for its object to provide mechanism of the character specified adapted to be arranged between the springs of a vehicle and the axle for cushioning and supplementing the action of the spring, and especially designed for cushioning the upward movement of the body with respect to the axle

SPRING CONTROLLER.—T. S. Howe, 2717 E 12th St, Kansas City, Mo The invention has for its object to provide a simple device for neutralizing the rebound of the spring, wherein the controller is arranged to assist in cushioning the downward movement of the body of the vehicle and to hold the same on the rebound at either or both ends, and wherein the side swaying or rocking of the vehicle is not interfered with.

WINDOW CLEANER.—A P. Bennett, 144 W 87th St, New York, N. Y. The invention relates to devices for mechanically cleaning accumulations of snow, sleet, rain, mud or the like from smooth surfaces such as windows or wind shields of automobiles or other vehicles Among the objects is to provide means that is adapted to operate independently of the driver of the vehicle without any attention on his part except to see that it is properly adjusted

POLE DROP —J W Petersen, 115 Hamilton St., Davenport, Iowa. The object of the invention is to provide a device of the character specified especially designed for supporting the pole of a carriage in horizontal position without any strain on the carriage when the pole is not in use, the said drop being pivoted to the pole to swing into and out of operative position.

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Where Is That Rattle?

(*Continued from page 17*)

If the motion is slight it produces a squeaking noise while if there is considerable play, the glass hitting the metal sides will cause a high pitched rattle which in common with loose lamp glasses is more evident at certain critical engine speeds than at others. A very annoying squeak results from poorly fitting demountable rim retention lugs. Six of these are used on each wheel of most automobiles, making twenty-four in all, and looseness of any one of these will result in a reoccurring squeaking noise every time the wheel on which the offending lug is placed turns around. There are times when the wedge portion of the lug has worn to such an extent that there will be a squeak no matter how tightly it is screwed up. In such a case a new lug that will have wedges of the proper size to fill the space between the tire rims and the felloe of the wheel must be applied.

If the brake bands, especially those of the external brake form, are poorly adjusted or the friction linings worn considerably, rattling noise will be produced by the brakes striking the brake drums. In many cars the brakes squeak when applied. The reason for this is that particles of sand and grit have worked their way into the brake lining and they cause a loud squeak when the friction band is tightened and they bear against the metal brake drums. The only real remedy is to clean off the lining which can only be properly done with the brake bands removed. Sometimes a few drops of oil between the brake lining and the drum will cure the trouble temporarily, but if this is carelessly done the cure will be worse than the disease, because the brakes are apt to slip when applied. It is better to use kerosene for this purpose than lubricating oil

In summing up it may be stated that most knocking and rattling noise is caused by an appreciable degree of lost motion between two members which should be in firm relation Squeaks generally result from a limited movement of insufficiently lubricated or dry parts against each other. Loud knocks are due to the loosening of an important retention member while rattling means lost motion between parts of lesser importance.

European Automobile Design for 1921

(*Continued from page 9*)

ered moderate in price on the other side, but which would be called high-priced here, would put up with considerable rear axle noise, so the spiral-bevel-driven axles did not interest the European car maker until a demand was created by the simple action of such gearing used on American cars and its efficiency so thoroughly proven. There is also noted a growing consideration for the comfort of passengers, inasmuch as there is quite a general tendency to lengthen the wheelbase and increase the tire sizes. Another refinement that the American motorist has demanded for a number of years and which is found on all American cars as standard equipment is now being applied by some of the European manufacturers, who formerly supplied it only as an additional item at an extra cost. This is the complete electrical starting, lighting and ignition system. With the adoption of the engine-driven generator to charge the battery used for starting and lighting purposes, it is natural to see the coming of the battery-and-coil ignition; and a number of European cars are being equipped with some of the most popular American systems or with copies of them, though most makers favor the magneto which seems firmly intrenched in Europe.

Considering first the engine design, we find that the majority of new cars now making their debut in the industry are using four-cylinder types. The detachable-head construction has been previously mentioned and wherever this type of cylinder is employed we notice a tendency to cast the cylinders integrally with the upper half of the crank case and with the fly-wheel housing just as it is in American practice.

As regards valve operation, indications point to increasing popularity of the overhead valve locations and a number of new engines follow aeronautical practice in that the valves are actuated by overhead mechanism driven from the crankshaft by vertical shaft and bevel gears The system of cam-shaft driving most popular in Europe is that using the inverted-tooth silent chain. It is said that this method appears in more engines than all the other types and possible combinations added together. In most of the engines side valves of the conventional poppet type are used European designers are conservative and are not inclined to jump at conclusions hurriedly. Therefore, the old type of engine, which is giving good satisfaction in numerous applications, is not apt to be displaced rapidly by the newer and more efficient forms based on the experience gained in building engines for aircraft

The situation as regards pistons appears to be the same as in years past There seems to be no growing desire to adopt aluminum for pistons other than by those makers already favoring them. It is safe to say that most of the engine builders are using cast-iron pistons, but more care is being taken in their design so that they are not any heavier than necessary In several instances steel pistons are noted and in one engine a combination or built-up piston of aluminum and cast-iron is employed.

In regard to the fuel feed methods employed, the American vacuum tank is growing more popular in England and is being used in France, though most of the French makers use the pressure feed system, using engine-driven air pump or exhaust pressure A large number of the British manufacturers, especially makers of light cars, favor the gravity feed from a tank placed under the cowl, as this is now used on about sixty per cent of British cars It has always been a European practice to carry a spare supply of gasoline in cans strapped to the running board or placed at other convenient points on the car, the universal fuel distribution system that we have in this country, where gasoline is obtained at numerous filling stations along the roadside, is not at all prevalent in Europe There the practice is to purchase the gasoline in small cans, which are sealed at the refinery to prevent dilution or adulteration by lower grade and cheaper fuels In order to eliminate the necessity of carrying these extra cans, some car designers have incorporated auxiliary tanks which retain a gallon or two of fuel for emergency use This supply can only be drawn on when the operator turns on the valve shutting this tank off from the system

Even in Europe, where the carburetor has been highly developed for years before it received much thought in this country, more attention has to be paid to carburetion of low-volatility fuels, and in this the design of inlet passages or inlet pipe heating methods has to be carefully studied The problem of providing suitable inlet passages between cylinders and in water-jackets, increases the difficulties of casting the cylinders en bloc, but nevertheless, it is becoming general to find that smooth-wall passages with easy curves and of low resistance are sought after. Passages having rough walls retard the mixture and prevent the engine from developing its full power, and lack of pre-warming facilities makes the engine sluggish in cold weather. There is some difference of opinion as to whether it is best to heat the inlet passage through contact with the water system, or through direct contact with the exhaust manifold, though all engineers favor some system of pre-heating to insure prompt and constant evaporation.

If any evidence were needed to show that automobile design is making progress, a study of lubrication systems would furnish it One finds that much more care is being taken, in regard both to obtaining efficient lubrication and to avoiding an excess which causes carbonization In this respect, the scraper piston ring has played an important part and has demonstrated that it is a valuable improvement on most cars. Improvements now evident on some designs and likely to be found eventually on all cars, mainly concern the provision of suitable filters which are not liable to clog, and which at the same time can be readily removed for cleaning without necessarily draining the lubricant from the crank-case sump It is also noted that designers are taking more trouble to see that filler spouts are placed in such a position that replenishments can be made easily without messing up the car and wasting some of the now precious lubricating oil

There are not many changes in water-cooling methods, such crude things as leather-belt-driven and friction-drive water pumps being still noticed on cars of very good make It is difficult to understand how the motorists continue to be satisfied with such makeshifts when it is such a simple engineering matter to design the pump as a component of the car driven by positive gearing, as is the case in practically all American cars

The magneto ignition system is the most popular in Europe The number of makers who have adopted battery ignition systems is remarkably small and most of these are people bringing out cars that are to be sold at moderate prices On some cars both magneto and battery ignition are provided, just as they were in the transition period from the magneto to the battery system in this country It does not seem reasonable that those who desire to use it should have to continue to furnish a magneto as standard equipment, or as a concession to popular opinion to bridge over the time until the motorist has been familiar with the fact that modern battery ignition systems are reliable These can not be compared to or confused with the earlier trembler coil and puny celluloid container storage batteries that have been discarded in America for so many years, but which are still seen in small numbers abroad In order to give successful service in the starting and lighting system a storage battery must be made substantial and of large capacity When it is made in this way, there is no chance of failure because a battery that is substantial enough to deliver the steady current required for lighting purposes and the surging discharge required by the starting motor will certainly prove adequate to supply the minute demands of the modern battery ignition timer and non-vibrator coil.

[*The* SCIENTIFIC AMERICAN *does not agree with Major Page in his ignition viewpoints As an illustration of the value of dual ignition, we would cite a recent experience when our battery was suddenly short-circuited so seriously that even the generator was not able to operate the lights through the battery We did not try it, but we are very certain we should have got no spark out of that battery; all the current we had was going into the frame of our car We naturally had no illumination to aid us in seeking out the trouble, and if we had not had the dual ignition we should certainly have stayed right where we were all night As it was, we were able to run with the magneto as though nothing had happened, and to dispense with our lights by sitting on the tail of the first passing car We do not know any good reason why the slight additional cost of the magneto should lead to the elimination of this admirable safe guard against ignition breakdown.*—THE EDITOR.]

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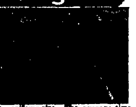

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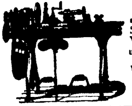

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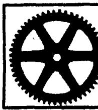

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One of the things that is noted in European practice which is very much different from American practice is in the mounting of the engine and gear-box in the chassis. In most American cars these two units are joined together to form what is termed a "unit" power plant. This greatly simplifies the installation though the units are not as accessible or as quickly removed as they would be if the engine were carried as a separate unit from the change-speed gearing The practice in the majority of English and French designs is to mount the gear box on a special frame member or one of the cross members of the main frame, entirely distinct from the power plant, to which it is connected by a short driving shaft. About twenty per cent of the European makers have adopted the unit power plant, but the remainder follow the conventional foreign construction outlined.

In a few cars the gear-box is mounted at the front of the propeller-shaft casing or on the rear of this casing close to the axle One point that is noted, however, is that the three-point "unit" suspension idea which originated in America is being *more widely adopted in Europe* even when the gear box and engine are separate units

A point that is a marked departure from modern American practice is that the cone clutch continues to be the most popular form, though the single plate or floating disk form is increasing in popularity Multiple plate clutches are found only on the more expensive cars, but here again an advantage is taken from American practice and instead of using metal disks as was the case before the war with the disk assembly running in oil, the newer clutches are of the dry disk type *having alternated metal faces with asbestos fabric friction surfaces*

The method of final drive known as the Hotchkiss system which includes an open propeller shaft with a universal joint at each end and in which all of the driving and braking torque stresses are resisted by the rear springs, made some gain last year, but has not increased in popularity this year While the completely enclosed propeller-shaft with one universal joint is found in probably fifty per cent of European cars, a modification is coming in *favor known as the semi-enclosed propeller-shaft* This consists of a short coupling-shaft between the change-speed gearing and the front end of the short torque which carries the propeller-shaft proper, this being supported at the front end by a frame cross-member

In regard to universal joints it may be said that the fabric disk joint is rapidly increasing in popularity and is being used in many cases where the double universal-joint, open-shaft drive is employed The leather or fabric disk is an advantageous type to use wherever the universal joints are run open and where there is no chance *for oil or grease to accumulate on the* disks It is said that British designers now favor them to the extent that one-third of British cars are equipped with them and that a number of the French designers have followed the lead established by America The flexible-disk joint requires no lubrication and is not apt to wear unduly Inasmuch as it is not good engineering policy to use a propeller-shaft having too great a degree of angularity, it will be observed that the leather-disk universals will be satisfactory. Where there is considerable flexure of the joint, however, the all-metal, bushed star type is firmly established, where the joint is housed in a ball at the front end of the torque tube

The worm-gear final-drive has never been very popular in America for passenger cars For a time a considerable number of foreign designers favored the worm-drive and it was used on very light cars as well as on the more costly creations of the designer's skill It is said that at the present time the drive situation may be summed up by considering twenty-five per cent of English cars as worm-gear driven and twenty-six per cent employing the straight-tooth bevel-gearing. The remainder of the cars may be said to use spiral bevel-gearing; the proportion using other drives is practically negligible.

Another thing in which American practice is being little followed is in the application of both sets of brakes to drums on the rear wheels. Instead of having one *set external constricting and the other* set internal expanding as is the customary *American practice, the majority of leading* designers favor internal expanding brakes for both service and emergency use. Only ten per cent of the British cars have brakes of the external band type

Considering the chassis suspension we find that the semi-elliptic type of spring is the most popular On light cars the quarter-elliptic spring is considered with favor by a number of designers. The proportion given in the *Auto Car* in reviewing current European practice is that *forty-nine per cent of the cars use the* semi-elliptic, eighteen per cent the quarter-elliptic, full cantilever is *found* in nineteen per cent and fourteen per cent of the chasses employ the three-quarter elliptic type

The disk wheel is becoming more popular, though it is gaining at the expense of wood wheels A point upon which the European designer is to be commended is in the careful thought given to refinements of detail on those minor engineering points that are so often neglected in American cars Such items as easily adjustable brake-rods and levers, the use of ball *joints on control linkage straight* operating rods instead of bent and off-set rods as are still seen to a great extent in this country, are found In America, ample precautions are taken to lubricate main units, but minor points are often neglected; in Europe this is seldom the case.

A number of interesting comparative charts which are reproduced from *Auto Car*, our English contemporary, will bring out the various features touched upon in the foregoing article Everything has been worked out on the basis of the number of cars shown at the recent Olympia and White City shows, which may be considered representative of European practice inasmuch as the makers from all parts of Europe had cars on display This comparison shows the general trend and implies that many *features* of American practice are now considered with more *favor in Europe at the present time than* they were in the days before the war If it had not been for the large number of American cars that were used by the Allied powers, and which proved satisfactory under some conditions of operation that caused trouble to the more finely adjusted foreign cars, it is probable that we would not see the adoption of so many strictly American ideas by the more conservative European automobile engineers.

The Heavens in January, 1921

(*Continued from page 12*)

Declinations 9° 1′ 48″ south—about 8 degrees south and a little west of Alpha Hydrae On December 17th it was observed by Van Biesbroeck at the Yerkes Observatory in 9h 17m 0s., 8° 10′ 7″ south, and was described as round, of the tenth magnitude, and visible in a small telescope. *Its apparent motion during* this interval was at the rate of nearly two degrees a day, northeastward. Since the earth, from which we view it, is moving eastward too, the comet's eastward motion must actually be fairly rapid, and it must be following an orbit with rather small inclination, and must be fairly near the earth. More cannot be said until the orbit has been computed, and until then we cannot tell whether this comet will become conspicuous.

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The Role of the Patent System in the United States

THE close association of invention and the Patent Office is indicated in the 1919 report to Congress of late Commissioner of Patents J T Newton: "The interdependency of industrial security and efficient performances of the functions of this bureau can only be realized by a study of that relationship and by a knowledge of the economic history of the country. It is no exaggeration to declare that the work of the civilized world is done mainly by instrumentalities which have resulted from the exercise of invention; that the energy generated by engines and devices invented since the first rumblings of the *American Revolution have multiplied the* power of mankind a thousandfold; and that if dependence were placed solely upon man's muscular efforts, the world in its present state could not exist In the production of food, to give one instance, the reaper and thrasher alone have done immeasurably more to increase the supply of man's basic need than all the agencies of educational propaganda and institutional assistance together It would be presumptuous to try to reckon the increased growth in property values due to the steam engine, the steamship, and the railroad It would stagger the *imagination to figure the* added prosperity given to the world by the Bessemer process alone. In the two departments of electricity and chemistry inventions in the last 40 years have provided an increment of wealth, productivity, and comfort beyond computation. The World War in its four years of destruction expended a greater amount of energy and required for its conduct more material of manufacture than was probably liberated by mankind or fashioned by all the world's peoples from the dawn of history to the invention of the steam engine Such efforts and such expenditures of material could *only come from* the processes and products of invention It illustrates and most emphatically *emphasizes the* fact that invention is the special pheunomena of our present time

"It is essential to our progress as is an established government to our security, and in the race between nations that country which provides the most enlightened patent system and which fosters most the inventive spirit is bound to win. For a little contemplation given to the subject will readily convince one that no method of personal improvement, no efficiency system, no particular political reorganization, is comparably potent to the results of a great invention in increasing production—the wherewithal of industry, commerce, and welfare No matter how the individual efficiency or the human element is increased, say 50 per cent, 100 per cent, or conceivably 200 per cent, there can not be competition with the results of invention, where a machine tended by a few men may perform the labor of hundreds, or whereby a process may perform miracles unattainable through any other agencies. * * *

"With all our remarkable advances in knowledge, we are but at the beginning of things There is no estimable limit to the extent of our acquirements, for we cannot begin to conceive of the actual nature of our world, of the fundamentals of our existence. There is so much to learn that no matter how far we go we have yet to traverse illimitable distances on the road to the infinite stores of complete knowledge. As our utilization of the secrets of nature is directly dependent upon how much of them we have discovered, so every advance in scientific knowledge opens up a vista of new utilizations. As invention is the channel through which science finds utilitarian expression, it is clear there are no ascertainable limitations to the advance of invention, to the benefits that may accrue to mankind through its exercise."

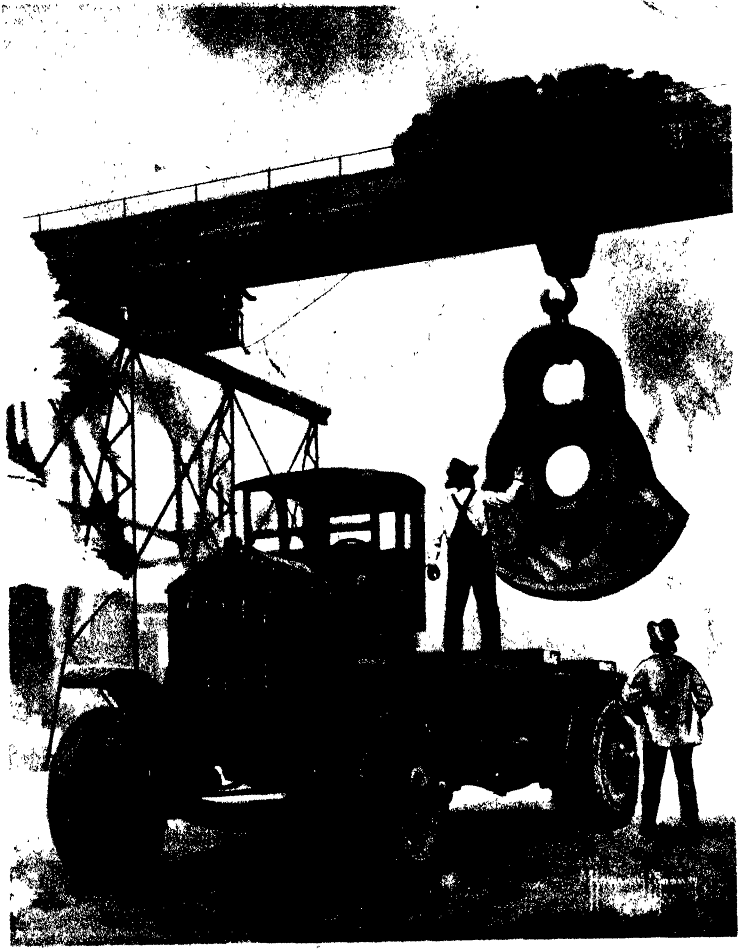
IN THIS ISSUE:

DOING AWAY WITH THE LOAFING CHARGE
FIFTY MOTOR TRUCK OPINIONS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



A VITAL LINK IN THE TRANSPORTATION SYSTEM OF THE NATION THE MOTOR TRUCK

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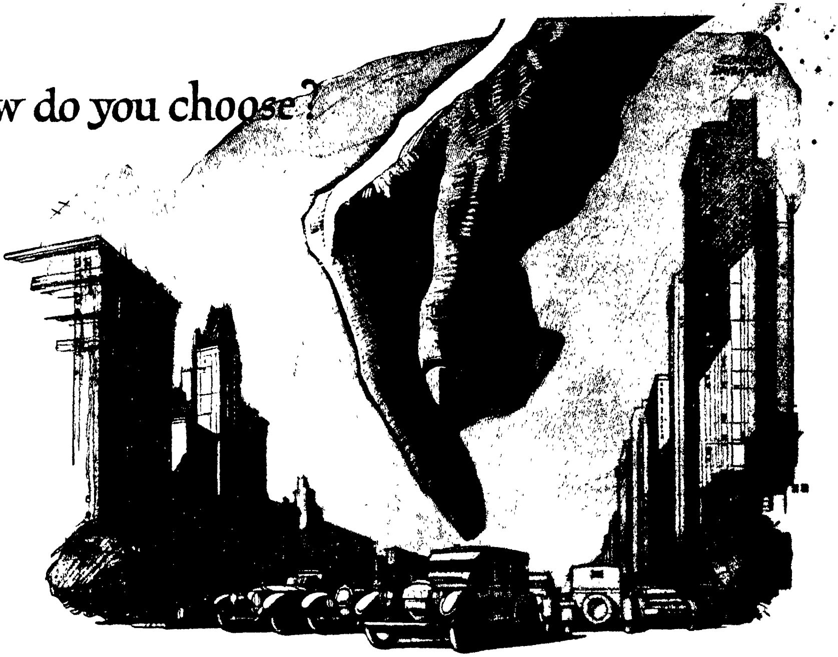

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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIV. NUMBER 2

NEW YORK, JANUARY 8, 1921

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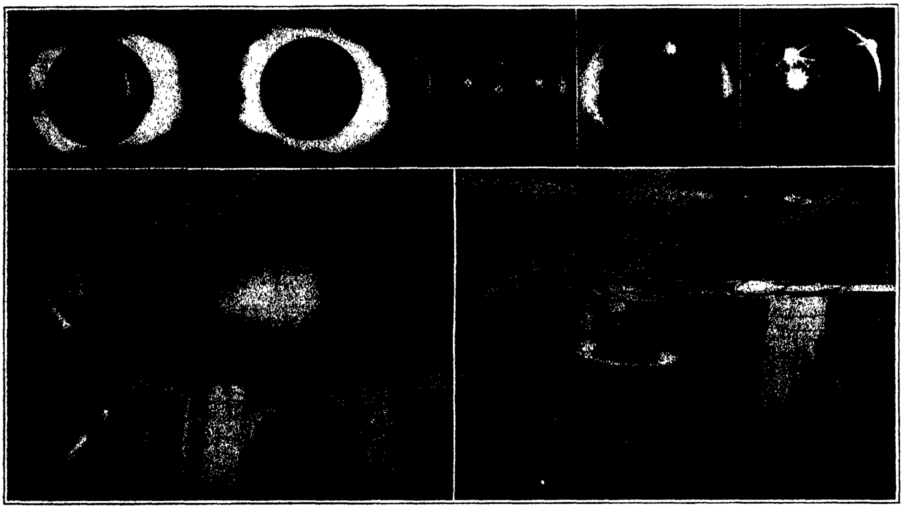

Two views of Dr. Birkeland's "terrella" outfit for producing on a small scale the phenomena of the solar system, and five of the conditions which he was able *to create on his copper "planet"*

The Solar System in Miniature

By M. Tevis

THE well-known Norwegian physicist, Birkeland, has recently devised an ingenious instrument for testing and demonstrating certain hypotheses of his with respect to the part played in our universe by electrical phenomena. It is now known that the sun is a powerful center of emission of electrons, these traverse space with a velocity approximate to that of light, and wherever they encounter rarefied gases they occasion luminous phenomena similar to those which can be observed within X-ray tubes. Dr Russell, in his article, "The Heavens for February," in the SCIENTIFIC AMERICAN for Jan 31, 1920, has told us something of these, and of the current theories which trace the magnificent aurora borealis to their effects

Even if these electrons do not proceed from the sun to the various planets they are capable of being generated by solar light and especially by the ultra-violet rays wherever they strike against a material obstacle. While physicists are still in doubt with regard to many aspects of the matter, it is generally believed that electric phenomena are capable of shedding light upon the tails of comets, the aurora borealis, and the magnetic storms which in polar regions cause so much disturbance in the ordinarily constant direction of the needle of the compass.

It is such questions that Birkeland had in mind when he constructed his miniature universe. This consists of a huge bell jar having a capacity of 70 liters, into which various gases can be introduced and maintained at any desired degree of pressure In the center of the jar is placed a "planet" 8 centimeters in diameter and called by the author the *terrella* This is a copper sphere within whose interior is an electrical magnet capable of being excited by electric currents in such a manner as to reproduce upon the terrella the equivalent of terrestrial magnetism On the side is a metal disk which generates electrons and which represents the sun.

By causing electric discharges to pass into the interior of the bell jar, luminous phenomena can be caused which undergo great variations according to the degree of rarefaction of the gas, the intensity of the discharge, and the degree of magnetization of the central globe Birkeland first employed this apparatus in 1908 for the study of magnetic storms on the surface of the sun.

In the course of these experiments upon the zodiacal light the physicist made an interesting observation to the effect that upon actually diminishing the intensity of the current of discharge which traversed the apparatus the wide ring which represents zodiacal light contracts, and shades off so as to form around the equator of the terrella a corona similar to Saturn's system of rings and formed, like that, of several zones of different degrees of brilliance, it is even possible to recognise a dark space analogous to the division of Cassini.

These facts at once directed the investigator's ideas in a new direction Saturn may be, like the sun, but to a less degree, a source of electrons; the latter, directed by the magnetism of the planet, produce in the rarefied gases which surround it a ring which is faintly luminous in itself, but which is also capable of reflecting the solar light toward the earth. This hypothesis frees us from many difficulties, since if we accept it we no longer have to explain the quasi-eternal equilibrium of material masses forming an ensemble so complicated and apparently so fragile as "Saturn's rings", further, the acceptance of this theory involves the formulation of various others which lead us rather far We should have to assume, to begin with, the magnetism of Saturn, of which we have no proof, but which is by no means impossible, above all we should have to explain how these rings of very rarefied gases are capable of being at once opaque, almost dark, and capable of reflection We know it is true that the tails of comets diffuse solar light like the dust which glitters in a ray of light in a darkened room, but these wandering comet tails also give forth a light of their own and they are so highly transparent that the most remote stars can be seen through their substances Finally, the rings revolve and this revolution would increase the gravitation The French astronomer, L. Houllevigue, in criticising Birkeland's hypothesis, declares that it fails to take into account this fact He believes further that it is best to hold at present with the accepted theory of Cassini while following with interest Birkeland's experiment It would seem that this is the proper conservative viewpoint to take toward these startling innovations

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs

World Hunger for Disarmament

IT was a happy thought in this season of peace and good will for the *New York World* to dispatch a *message to leading men throughout the world,* asking for their sentiments and opinions on the subject of disarmament The replies reveal a practically unanimous and evidently very sincere desire on the part of civilization to get rid of the enormous financial war burdens which we are still *carrying, in spite of* the fact that a great world war for the vindication of justice and humanity was recently brought to a victorious conclusion.

It was at first sight illogical, but on second thought *perfectly consistent that this questionnaire should* have been sent out from the United States It was illogical because our Navy Department is the one power which has an enormous program of warship construction in hand, It was fitting because, outside of the *Secretary of the Navy and a small minority of naval* officers, the Navy as a whole and the citizens of the United States as a whole believe that we should cut down rather than increase our naval appropriations, and that as a people we should take the lead in disarma*ment and the substitution of reasonableness and* justice for the arbitrament of the sword

It is in the nature of things that this appeal should find a more ready response among civilians than in naval and military circles, but we would remind the *latter that the history of the two* leading powers in the world today affords a notable case, in which an agreement for the discontinuance of armed protection was drawn up and put in force at the close of a bitter war in which they had been engaged We refer *to the war of 1812 and the agreement* of the United States and Great Britain to set no fleets of fighting ships afloat upon the Great Lakes, and to limit their construction in these waters to one or two small gunboats designed purely for police and patrol duties This *momentous and extremely significant agreement* was drawn up and signed over a century ago and has been most faithfully followed Moreover along the whole stretch of mutual frontier, reaching for over 3,000 miles, there has not been erected during the intervening *century a single fortification*

Nobody, of course, demands that any such sweeping elimination of warships should be made upon the high seas The policing of the seas and the keeping open of the trade routes call for the maintenance of fleets, *whose relative strength should be drawn up* after a careful and friendly consideration of the relative responsibilities and liabilities of the two nations—a delicate and difficult problem, but one that is entirely possible of solution if the representatives of the two powers *gather together in a spirit of mutual* confidence and fair play In the one case we have an inland empire, self contained and so strong in population, wealth and natural resources that it is unconquerable by any conceivable hostile combination In the other case we *have an island empire* that is scattered over every quarter of the globe, and whose very existence depends upon the freedom of the seas and the maintenance of the highways of commerce, so that her ships and those of the nations of the world may come and go as they please

If such a happy solution of the problem was so quickly found at the close of a bitter war between the *two countries, it should certainly be possible to* find an equally happy solution at the close of the late war for civilization, in which the two countries fought side by side as loyal and mutually appreciative allies. It is the belief of all thoughtful Americans that our beloved country stands just now at the parting of the ways. The fortunes of war have left us in a commanding position, and with an influence in international affairs which not even the most sanguine among us believed would be ours for many a decade to come. Upon the use which we make of this heritage depends to an immeasurable extent the future peace and happiness of the great world of which we form a part. If our statesmen are guided by the spirit of Washington and the spirit shown by his worthy successors in the evermemorable agreement as to armaments on the Great Lakes, they will have the opportunity, during the next few years, to write some of the most glorious and honorable chapters in the history of this country.

A Neglected Transportation Facility

IF it were not for the inertia of habit and tradition, that most admirable method of transportation known as the moving platform would be today one of our recognized and most effective means of transportation. Its neglect is not due to the fact that we know nothing about it in a practical way, for nearly thirty years ago a moving platform formed one of the notable exhibits at the World's Fair, Chicago, where it carried multitudes of people without any mishap.

Fundamentally, the difference between a moving platform and a train of cars is that in the first case the wheels are attached to the car and move with it, and in the second the wheels are attached to Mother Earth and the cars move over them.

And why not?

Habit, it is true, tradition, custom, the immemorial habit of "passing the buck" and all sorts of other human inhibitions cry out against such an unheard-of thing as taking the wheels off the cars and bolting *them to the track.* But we are already doing this in that most brilliant device for transporting freight, known as the belt conveyor, and if the conveyor is so efficient in carrying wheat, coal and miscellaneous freight, why should it not show the same efficiency *in the carriage of people?*

For the moving platform is neither more nor less than an endless conveyor belt for the transportation of people in bulk, and on a scale that is not approached by any other system of transportation.

As the more mature among our readers will remember, we commenced to advocate the moving platform many, many years ago, and we are gratified to note that Mr Turner, the chief engineer of the Transit Construction Committee, in his recent report of future extensions of *our subway* system, puts in a strong plea for the moving platform. In showing the superior advantages for crosstown service of moving platforms over shuttle service, it is sufficient to state that whereas the horrible shuttle service in the subway between Grand Central Station and Times Square has a maximum capacity of, say, 10,000 people per hour, a platform running at three, six and nine miles an hour could handle over 80,000 passengers per hour each way.

In his study of the subject, Mr. Turner has set forth the advantages of moving platforms over shuttle trains as follows There will be but one long walk instead of two at transfer points, no period of waiting and no congestion on platforms, there will be a saving of time in transfers, a tripling of the passenger capacity and a seat for every passenger

The great carrying capacity of moving platforms is due to two facts: first, that they move continuously, without any stops, at a speed of nine miles an hour; and secondly, that there would be stations at every block instead of one at intervals of from five to ten blocks A platform next to the stationary platform moves at only three miles per hour, an intermediate platform at six miles per hour, and a third platform, upon which are the seats, at nine miles per hour. Therefore, the enormous capacity of this system is due to the fact that the passenger can board and leave the platform at any street corner without delays due to stopping or crowd congestion.

Railroad Electrification in the Rocky Mountains

IT is well understood that the economics of the substitution of electricity for steam traction are intimately related to the topographical and other conditions where the proposed change is to be made. Also it has been proved that nowhere does electrical haulage show its superiority over steam so markedly as on the steep grades of the mountain divisions of our railroads, particularly if the stretch of track to be electrified is within the economical transmission radius of hydro-electric power plants.

The most important development of this character is the electrification of the lines of the Chicago, Milwaukee and St. Paul Railway between Harlow Town and Avery, where they cross the American Continental Divide. From the engineers' and the operators' standpoints, this is an unusually heavy division, since three mountain ranges have to be crossed whose successive elevations are 4,150, 6,322 and 5,788 feet. There are over twenty miles of two per cent grade and a maximum curvature of ten degrees on this division The total length is 438 miles. These figures, better than anything else, give an idea of the heavy duty required of the electrical service in hauling the heaviest freight and passenger trains to and fro over the Rockies in this locality.

So successful has been the installation that it was decided to make a similar change where the tracks of this railroad cross the lower but still very formidable divide of the Cascade range. This stretch of line is something less than one-half the length of the Rocky Mountain crossing, and the two summit elevations are less than one-half those in the Rockies. On the other hand, there is nearly twenty miles of 2.2 per cent grade against the westward traffic. It was opened during the past year, with the result that there is now 647 miles of main line and another 200 miles of sidings and other tracks, making a total of over 850 miles of track that has been changed from steam to electric traction. Great credit is due to the company for the enterprise which it has shown in putting through this great transformation

The problem of the electrification of tracks which run through fairly level and what might be called easy country is represented by the electrified sections of the New York Central and the New York, New Haven and Hartford Railroads, the one using direct current and the New Haven, the alternating current. In the interests of the art, it is to be regretted that there has not been any definite statement made public as to the relative cost on these two roads of electric and steam traction. It is true that the installations were made more as a matter of necessity and convenience than with the expectation that there would be any considerable reduction of costs. The change at the Grand Central Terminal was due to the pressure of the law, coupled with the conviction on the part of the New York Central Company that the change from steam to electricity would make possible a great saving in train movements, to say nothing of the possibility of putting the train yard below street level and building the present magnificent terminal, undoubtedly the finest work of its kind in existence and a lasting tribute to Colonel Wilgus, the engineer in charge of the work. We do not know whether the two companies have kept any separate account of the operating costs in the terminal, as distinguished from those of the electrified sections of their main lines. The New York Central electric zone extends thirty miles and the New Haven line for about seventy-five miles from this city.

Most valuable figures have been published regarding the Chicago, Milwaukee and St. Paul Division with instructive comparisons of steam and electric costs; but so far as the two eastern roads are concerned, we believe that no official comparative statement has been made public. In the absence of any such, the public will inevitably presume that here at least electric traction has not shown a similar economy over steam.

The greatly increased cost of fuel, both coal and oil, should stimulate the railroads of the United States to a new study of the problem of electrification. Because the change from steam to electricity showed no corresponding profits and possibly a loss a dozen or fifteen years ago, it does not follow that it would not be profitable today.

Electricity

A Heater That Is Proof Against Fire.—For guarding against danger of fire or scorching, a new heater is being brought out by an American company with [illegible] safety features. An automatic gravity switch is mounted in the base of the heater, and when the latter is tipped over, or flops down, the switch disconnects the current. When the heater is righted the current is automatically turned on again. The bowl is also so shaped that it cannot be tipped down far enough for the heat rays to strike the floor. The heater, it will be understood, is of the concentrated, reflector type.

Machine for Winding Lamp Filaments.—From a recent issue of *Electrical World* we learn that a machine for automatically winding or concentrating coils used in nitrogen, gas-filled and miniature lamps has been designed by Charles Eisler of Newark, N. J. This machine is designed to wind 15-watt to 1,000-watt coils of 25 to 900 turns per inch with a core from 0.002 inch to 0.035 inch. The speed is from 800 to 3,000 revolutions per minute, depending on the size of wire. The wire can be heated electrically to a cherry red while being wound. It is possible to coil about 6,000 feet of wire in one length, the amount varying with the size of the wire.

Asbestos-Covered Magnet Wire.—In the usual burnouts of solenoids and motor windings it is the insulation only that is burned; the metal generally remains intact. So it is interesting to note that a manufacturer has introduced asbestos-covered magnet wire which should go a long way toward reducing the probability of burn-outs in electrical devices of various kinds. The new wire is intended for armature coils in particular and is said to have high dielectric qualities. It is proof against moisture, fire, acid and oil. The coating of asbestos is treated with compound in such a fashion that it resembles rawhide. It is claimed that the wire is practically immune to hammer blows and that the conductor can be deformed without damaging the insulation.

Insulated Tools for Electric Railways.—The introduction of the third rail on electric railways has rendered it difficult to carry on certain repairs on the rails and road bed. Great care must be taken in order that tools will not come in contact with the live rail, and this is by no means a simple matter where common labor is a factor. Several methods have been tried to insulate the tools, such as winding insulating tape about metal parts of tools or using rubber sleeves, but these fail either in the electrical or mechanical sense. From England comes a worthy solution of the insulated tool problem, in the form of special tools which are divided and insulated into short sections. These sections are such that it becomes impossible to span the distance between third rail and regular rail, in an electrical sense. At the same time the strength of the insulated tools is practically that of the uninsulated tools.

Submarine Cable Transmission.—A recent paper published by the *Journal* of the Franklin Institute deals with the experiments of Frederick E. Pernot in an attempt to develop a method of signal transmission over submarine cables which would permit of a more effective use of existing cable systems. By this scheme signals are transmitted by means of alternating currents simultaneously with the normal battery, or direct-current, operation of the cable. Currents of several different frequencies may be used, reserving a given frequency for each message, and by tuning or equivalent methods at the receiving end these messages may be separated, so that the simultaneous transmission of a number of messages is rendered possible. Actual trial of the proposed alternating-current method was made over [illegible] distances up to approximately 700 kilometers with results which are said to be completely satisfactory.

The Longest [illegible] Line in the United States was recently opened to the public by the Western Union Telegraph Company, giving direct communication between New York and Seattle. The circuit is of the "[illegible]" type, the operator at each end punching a tape by means of a keyboard for transmitting purposes, while an automatic typewriter receiver takes down the incoming messages in finished form. Throughout the entire length of the New York-Seattle circuit [illegible] relays, mechanical repeaters being used to relay the messages through the various circuits [illegible] the line. Four messages simultaneously [illegible] over the single copper wire, [illegible] at each end, or something [illegible] each way per hour. The cost of the [illegible] is estimated at a little more than [illegible] cost of construction, including labor [illegible] approximately [illegible] per mile.

Astronomy

The American Association of Variable Star Observers now has a membership of 69, and during the past year made more than 9,000 observations on 395 stars. During the years 1912 to 1920, inclusive, the total number of observations amounted to 109,294.

Radial Velocity of Nova Cygni.—The radial velocity of Nova Cygni No. 3 was determined by Messrs. Adams and Joy from the H and K lines on 15 spectrograms to be 18 kilometers a second. As the component of solar motion in the direction of the star is 18 kilometers a second, the star has probably no appreciable velocity relative to the stars in general.

Mrs. Fiammetta Wilson, a leading English observer of meteors, died July 21, 1920. Just before her death she had been selected by Harvard College Observatory to receive the first "Edward C. Pickering Astronomical Fellowship for Women." This has now been assigned to her colleague in meteor observations, Miss A. Grace Cook, F. R. A. S.

The Circulation of Calcium About Sunspots has been studied by Mr. Philip Fox on a series of spectroheliograms made with the Rumford spectroheliograph of the Yerkes Observatory in the years 1908 to 1909. The direction of rotation around single spots seems to be definitely anticyclonic for both hemispheres and in both high and low latitudes. The motion about bipolar spots is cyclonic for the leader and anticyclonic for the trailer.

Map of the Sunspot Spectrum.—The Mount Wilson Observatory has just published a large photographic map of the sunspot spectrum, covering the region between wave-lengths 3,900 and 6,600. The negatives from which the map was made were taken wit hthe 75-foot spectrograph used with the 150-foot tower telescope, and were enlarged to a scale of one centimeter to the angstrom, in order to show the separation of the lines caused by the magnetic field of the sunspot.

One Hundred New Spectroscopic Binaries.—The Dominion Astrophysical Observatory has published a list of the first 100 spectroscopic binaries discovered at Victoria since the work was begun there in May, 1918. The variable velocity of these stars in the line of sight—the indication of their binary character—was discovered in the course of observing radial velocities of 576 stars between the 5th and 10th magnitudes, in accordance with the program of such observations carried on in coöperation with the Mount Wilson Observatory.

Records of Double Stars.—Mr. S. G. Barton, in a notice of the late Prof. Eric Doolittle, director of Flower Observatory, tells us how S. W. Burnham, the world's leading authority on double stars, turned over his library and manuscripts to Doolittle in 1913, and how the latter had since been gathering a vast fund of material toward a supplement to Burnham's "General Catalogue," published in 1906. In accordance with Professor Doolittle's wishes, the continuation and eventual publication of this work has been entrusted to Dr. R. G. Aiken, of the Lick Observatory.

Karl Herman Struve, director of the Berlin-Babelsberg Observatory, died August 12, 1920, at the age of 66. He was born at Pulkova, Russia, where his father, Otto Struve, was director of the observatory. His grandfather was the equally celebrated astronomer F. G. W. Struve. All three representatives of the family were gold medallists of the Royal Astronomical Society, of England. The last Struve's earliest and most important astronomical work was done at Pulkova. He became professor of astronomy and director of the observatory at Königsberg in 1895, and succeeded Foerster as director of the Berlin-Babelsberg Observatory in 1904.

The American Astronomical Society held its 24th meeting September 1-4, 1920, at Smith College, Northampton, and Mount Holyoke College, South Hadley, Mass., both colleges for women. The directors of the observatories of the two institutions are, respectively, Miss Harriet W. Bigelow and Miss Anne S. Young. According to its constitution, the society may elect one honorary member at each annual meeting, and Sir F. W. Dyson, the British astronomer royal, was thus honored at the meeting above mentioned. The relations of the society to the National Research Council are such that the society controls the American Section of the International Astronomical Union, which is expected to meet shortly before each of the triennial meetings of the international organization. The next of these will be held in 1922. The executive committee of the American Section now comprises W. W. Campbell, chairman; W. S. Eichelberger, H. N. Russell, Frank Schlesinger, and Joel Stebbins, secretary.

Engineering

A Coating of Magnesia Cement on the timbers of mines is stated to be an economical and efficient assurance against fire, especially in the arid regions where timber becomes highly inflammable and is difficult to replace. It is elastic, adheres firmly to almost any surface, and is stable and durable.

Benjamin Holt, of caterpillar fame, died early in December Mr. Holt was the inventor of the machine that bears his name, and the one from which it is generally understood that the British army engineers got the immediate inspiration for the tank. While the track-layer more than most inventions was anticipated in more or less completeness by numerous early inventors, it is equally true that the work of these pioneers to an unusual extent died with them, and Holt is recognized as responsible for the appearance of this principle in modern tractor engineering.

The Mechanical Side of Turbo-Generators.—It is said that one pound of material in the present 5,000-kw. turbo sets does the work required of five pounds in the first 5,000-kw. set built in this country, according to *General Electric Review*. Stator construction has reduced itself to the simplest form as the requirements of rigidity, light weight and flexibility are best fulfilled by such a design However, high speeds and increased capacities have introduced real difficulties in the construction of rotors The centrifugal stresses have necessitated the use of a solid forged rotor, and in the largest machines it has been desirable to use a three-piece rotor because of the great length and weight of a solid one-piece forging. Ventilation, which is of prime importance in the modern turbo-generator, is also receiving careful attention on the part of engineers and designers.

The Color of Cypress.—Southern bald cypress is about the most variable in color of any of our native woods, and in different localities is known as red cypress, yellow cypress, white cypress and black cypress. There is a rather prevalent belief that cypress with dark colored heartwood is the most durable, but the opinion of the U. S Forest Products Laboratory is that as far as durability is concerned, the color of the wood makes very little difference. In service records obtained by the laboratory, any difference in the length of service of red cypress and yellow cypress appears to be due entirely to a difference in the amount of sapwood in the timbers. Cypress trees with light-colored heartwood usually have more sapwood than those with dark colored heartwood, and sapwood is not resistant to decay. The important thing if durability is desired appears to be to select the heartwood of cypress regardless of its shade.

Light Weight Construction for Light Loads.—Does it not seem uneconomical to design a floor construction which weighs nearly as much as the load it supports? Yet this is what must be done with many types of fireproof construction to support loads such as occur in apartment houses, schools, hotels, office buildings, and so on. A great part of the materials of construction is thus used to support itself. Thus a steel company directs attention to its light-weight pressed steel beam which has been introduced for light-occupancy buildings. The beam is light in weight and correspondingly easy to handle—one man can carry this beam about without undue strain—while only a minimum of materials is required for the floor and the ceiling. All members of this light beam construction are shop fabricated, saving field work, and it is only necessary to set the beams in place, attach metal lath and apply plaster and concrete. No centering nor forms are required.

Pre-Cast Concrete Roof Trusses.—Reinforced concrete was substituted for steel in the construction of the shed on Pier No 6 at Cristobal, Canal Zone, at a time when steel deliveries were uncertain and the cost of steel high. Pre-cast concrete trusses were used for the roof with marked success and economy, we learn from *The Technical Review*. The shed in question is 945 feet long and 159 feet wide. It has a clear height under the trusses of 25 feet. Each truss is composed of 3½ cubic yards of concrete, contains 1,000 pounds of steel reinforcement, and weighs about 8 tons. The cross trusses are about 39 feet in length, 7 feet in depth, and extend from column to column. Each contains 8½ cubic yards of concrete, 4,000 pounds of steel reinforcement, and weighs 19 tons. The entire pier is covered with a roof slab 3½ inches thick, which might advisably have been made thicker to minimize deflection and tension cracks. Owing to the absence of wind, snow and ice loads, a live load of only 10 pounds per square foot was used in designing the roof.

Doing Away with the Loafing Charge

Loading and Unloading Apparatus that Helps to Keep the Truck Always Productively Engaged

By Victor W. Pagé, M.S.A.E.

THERE are a number of conditions which must be taken into consideration if one is to operate one truck or a fleet of trucks economically. We have previously considered in these columns the importance of systematic maintenance and lubrication. The evils of over-loading have also been considered and considerable space has been devoted to the use of trailers as a means of increasing the hauling capacity of the motor truck.

There are a large number of items entering into the cost of operation, some of which can be taken care of by careful mechanical supervision, adequate lubrication and careful driving There is one big item, however, that is usually beyond the control of the driver or those responsible for maintenance. This is the idle time of the truck, which helps to determine the actual operating costs This depends on a number of factors, some of which can be controlled by proper mechanical supervision, while others call for executive consideration and direction. For lost time due to waste labor in loading or unloading the truck on account of the failure to provide the proper mechanical appliances to facilitate the work, no one is to blame but the truck owner or the executive directing the use of the trucks.

An excellent example of a body designed for a specific purpose. It permits the carrying of the maximum number of empty barrels

Whenever it is necessary to load heavy or loose material into trucks, it takes considerable thought to devise means to keep the time down The time required for loading is said to be a more serious matter than that of unloading in handling many materials, so motor truck builders and those using them are trying to reduce this operation by the construction of ingenious special bodies and various loading devices

Bulky materials of large size—such as baled hay and cotton, barrels, furniture, boxes and crates—are very easily handled because they can be moved from the loading platform directly to the body or platform of the truck and stowed away with comparative ease by the driver and his helper or by laborers employed for that specific purpose Where a large variety of freight is handled, composed of parcels that differ greatly in size and weight, such as in furniture moving and in the express business, it is necessary to rely mainly on roustabouts for handling them Materials with some degree of uniformity in size, such as gravel, road metal, ashes, dirt and coal and any other substance that is usually stowed in piles presents a problem that may be solved easily by using mechanical loaders.

In some cases scoop or bucket loaders operated by conveyor machinery greatly reduce the cost of loading a truck. As an example of how these mechanical devices cut down idle time, we are told that a certain amount of coal that required the labor of several hand shovelers for twenty minutes was loaded by one shoveler and a mechanical loader in about three minutes It has been estimated that in transferring crushed stone from the ground to a motor truck body the cost of hand shovelers is about twenty cents per cubic yard. With a mechanical loader the same amount of work can be accomplished at a cost of two and a half cents per cubic yard In contracting work a steam shovel, which can dump its load directly into the motor truck body, will do the loading at even less cost than the figures mentioned so that the great advantage of machinery over hand labor is apparent.

In certain lines of business where a large number of small packages are carried that do not vary much in size, as in department store deliveries, the removable rack system is an important method of reducing the cost of both loading and unloading. Such racks are extremely valuable in moving goods from a warehouse to retail stores or from the main delivery stations to branch stations in outlying districts where lighter trucks or delivery wagons can handle the distribution to the individual consumer Such racks are really special, but simply constructed bodies provided with sturdy truck caster wheels.

If heavy material is to be handled, such as paving blocks, bricks, boxes of canned goods, castings, etc., it is to be expected that the rack must be much more substantial in construction and be fitted with wheels adapted to run on light rails so the loaded rack can be easily moved from the loading platform to the truck chassis. The method of keeping the rack in place after it has been put on the body can be worked out by a number of simple expedients, such as rods on each side of the chassis provided with quick action clamps or turn-buckles that will engage hooks on the body sides.

When light goods are handled the rack may be lifted into the body of any ordinary delivery wagon. In many department stores the delivery of the parcels is made easier by using large fiber containers or wicker baskets, roughly about four feet wide by six feet long by four feet in depth. These are provided with wheels at the bottom so that they can be readily moved from the packing room to the loading platform and from that point to the truck body. It is the custom in the packing room to arrange the distributing so that each basket or group of containers represents a different delivery district. While the truck is in motion the helper usually sorts the packages so that they can be delivered in routine order when the district in which the delivery work is to be done is reached.

If a truck is designed for handling heavy material, it is a great advantage to provide a davit on the side from which a chain hoist may be suspended so that heavy packages, barrels, castings, etc., may be easily lifted into the main body. Quite a number of trucks built for special duty work are provided with winches mounted on the truck body platform at the front and just back of the driver's seat or at the rear end of the chassis. While some of these winches are operated by hand cranks and reduction gearing, most of them are operated from the engine. An excellent example of the practical use of a winch or windlass is on those trucks used for moving safes and pianos. In this case the truck power plant not only furnishes the energy for transporting the heavy load, but through the medium of the engine-driven winch, it furnishes power enough to unload it from

(*Continued on page 33*)

1. The standard type of dumping body with hydraulic hoist, a quick way of unloading a large variety of materials. 2. Truck body fitted with traveling hoisting mechanism to facilitate loading and unloading heavy material. 3. Truck and trailer outfit used for hauling finished lumber in Havana, Cuba

Some of the means at the disposal of the truck owner who seeks greater utilization of his trucks by cutting the time spent in loading and unloading

Aircraft for Pleasure

By Bertram W. Williams

IF the history of the automobile is to be repeated, the airplane must first prove itself to be a reliable and efficient instrument of pleasure before it can hope to be a commercial success. The business man by the very nature of things must be cautious in experimenting with new and practically unproven methods. It has taken years to impress upon the public that the air is as safe a route of travel as any other provided proper machines and precautions are used, apart from it being infinitely more swift and comfortable. It now remains to convince commercial interests that the airplane is an economical means of transportation.

The success of aircraft in the war, far from advancing the cause of civilian aviation, has really made the average business man to be somewhat suspicious of its use as a substitute or even auxiliary of the proven automobile and truck. This idea has not been corrected by the daily press, which still persists in regarding all kinds of flying machines as dangerous and expensive toys. To combat this theory it is essential that the public be educated to look upon flying as nothing out of the ordinary—neither a hazardous nor very costly occupation. When that is accomplished, the vast field of its uses in the future will soon be realized

In the past, manufacturers have given little attention to the general public as a possible customer; they have rather concentrated on Government and War Office orders, where excessive power has been the dominating need, and cost of construction and economy of upkeep negligible factors. Once the aircraft industry devotes its time to making these two latter details their chief consideration, flying will soon become as common as motoring.

The automobile was for a long time dependent on good roads before it became popular with the general public, but if present-day machines were only capable of traveling on paved highways, they would still be a comparative rarety in this country, where four-fifths of the roads are far from ideal. Just so must the airplane be made more or less independent of large and specially prepared landing fields.

One of the chief exhibits at the San Francisco aircraft exposition, held some time ago, was a small machine built solely for pleasure purposes by the Longhead organization of Santa Barbara, and there are so many novel and interesting features about this miniature airplane that it is worth describing in detail. The "S-1," as it is called, is a single-seater biplane with a wing span of 20 feet, and a total weight empty of only 400 pounds. Everything about this little airplane denotes a refinement and finish worthy of the best French and English machines, and lacking, it must be confessed, in most of our domestic craft. The fuselage is of the monocoque type, consisting of a thin shell of plywood reinforced by transverse bulkheads. This form of fuselage has long been acknowledged to be the most successful on account of its ideal streamline form, and its strength in proportion to its weight. Heretofore, it has, however, been little used on account of the laborious methods necessary which made it exceedingly expensive. The shell in the Longhead model is produced by applying three complete layers of plywood to a mold the shape of the body; binding cloth and casein glue being applied between the layers, which are then subjected to a uniform air pressure of 20 pounds to the square inch, which is maintained over the entire surface until the glue has set This process produces a wooden shell one-eighth of an inch thick which is said to be stronger for its weight than any other fuselage yet developed. The upper and lower wings are supported by a V-shaped strut near the wing tips which is solidly bolted to the upper wing spars and fastened to the lower wing by a simple but rigid pin connection. The most novel and original features of this machine are the air brake and the position of the radiator. In the former, the lower wing spar is made to pivot at the body, allowing the whole wing to rotate, not only forming a very efficient lateral control, but allowing the lower plane to be thrown into a vertical position which provides an extremely effective brake, making it possible to stop the plane within about 70 feet of the point where the wheels first touch the ground, thus solving one of the chief problems of aircraft construction since the first flight of a heavier-than-air machine This simple and ingenious brake is operated by a separate lever beside the pilot's seat.

The designers claim that the machine will land at the exceedingly low speed of 25 miles per hour, while its maximum speed is said to be 75 miles per hour—a greater range than any other present-day type There is no reason to doubt these figures, as the almost ideal shape of the fuselage and the general distribution of weight have made it possible to operate the machine with an engine of only 25 horse-power. In these days of gigantic horse-power one would be apt to scoff at such a puny power plant till it is remembered that Bleriot crossed the English Channel in a far clumsier and heavier machine with an engine of similar power and decidedly inferior cooling qualities

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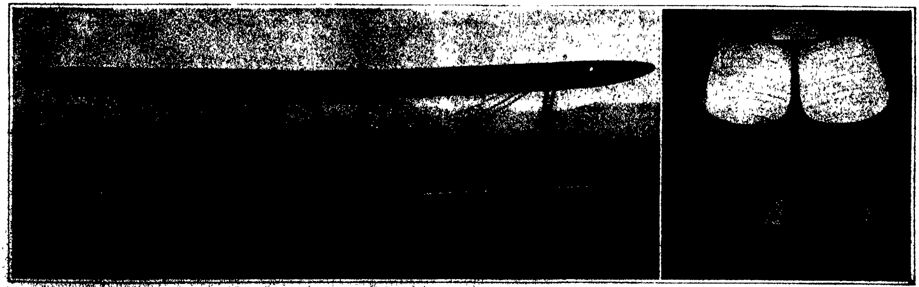
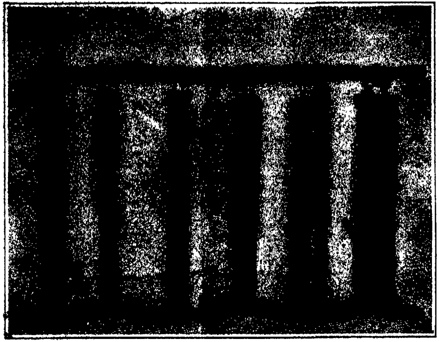


Two views of the Longhead biplane, which represents a serious American effort toward producing an airplane for general sport purposes

The Efficient Tire Pump

By Ralph Howard



Successive stages in the development of the tire pump, starting with the simple check valve type and ending with the triplex type

SINCE the time when pneumatic tires proved their superiority over hard and cushion construction for bicycle equipment, the pump has been a tool for serious consideration. Forgotten and often abused in long periods of idleness, to be hauled out in times of stress and hurry, it has never enjoyed much popularity

Idleness often destroys its usefulness more than operation. Satisfactory performance depends on flexibility of the leather cups This is retained by oil. Tubes are often dented or leaks caused by carelessness If the love of the fisherman for his rod or the hunter for his favorite gun could be felt by the motorist for his tire pump, much of the difficulty would be overcome

The great increase in volume of the automobile tire complicated the problem. Single action pumps of small diameters had been used Makers at once turned to larger diameters, but found this plan had its limits, as it was humanly impossible to push down the large plunger against the higher back pressure It was found that a 1¼-inch cylinder was about as large as could be used to get the specified pressures The pumps already being longer than the average user would utilize in making a stroke, the capacity was thus fixed To overcome this the two-cylinder pump was developed

Since the energy necessary to push down a plunger against a given pressure varies directly in proportion with the area of the plunger, the idea was conceived of starting with a 1½-inch cylinder and compressing the air on the down stroke through a cross over in the base into a ⅞-inch tube parallel to it. The ⅞-inch cup acted as a check until the up stroke when it forced the charge into the tire, combating the back pressure with its limited area It was found that this pump could handle more than twice the amount of air per stroke of the single action 1¼-inch, while it met with less resistance in getting it through the tire nipple.

One pump maker has recently realized the advantage of carrying the compounding principle even one stage further, and has designed the triple pump. This takes the air into the top of a 1¾-inch tube, delivers it on the down stroke into a 1¼-inch cylinder in exactly the same way as the double compound pump did On the up stroke this air passes over at the top and is trapped in a ¾-inch tube from which it is expelled into the tire by that very small plunger

The advantages gained were that the three-stage pump had *five times the capacity per stroke* of a 1¼-inch single and about *twice* that of the double It combated back pressure on the down stroke when the weight of the body could be utilized And yet the maximum operating effort was found by actual test to be almost equal The greatest gain of all, perhaps, was in getting air through the tire valve, as the flow of air became almost continuous, while with the other pumps, the singles especially, air was expelled in short, jerky gusts which permitted the tire valve to close after each stroke, and, of course, necessitated its reopening, thus greatly increasing the friction and the total amount of energy necessary to getting the tire up to pressure in a given time.

Fifty Motor Truck Opinions

What the Leading Automotive Authorities Have to Say About Highway Transportation

As Reported by Austin C. Lescarboura

THIS is the era of the motor truck. Yesterday it was the railroad; before that it was the stage coach; and still further back it was the canal. The motor truck, and by that we mean modern highway transportation, has come into its own. It has defined its field of service and established itself therein. In the field of short-haul transportation, the motor truck is the last word in efficiency.

So much for our introduction. But during these trying days of economic readjustment, following hard and fast upon a period of wartime and extravagant production and even over-production, it is well to take an inventory of the motor truck by way of determining its present status on the one hand, and of determining how it may best be used in the coming days of greater efficiency and healthier competition in all lines of endeavor. To that end we have gone to the engineers and designers and leading officials among motor truck builders—the spokesmen of the automotive industry, so to speak—for the inventory which we present in the following paragraphs:

The Paramount Question—Good Roads

The beginning of the year 1921 will see some forty-odd legislatures in session, all of which will consider, at least in a measure, the cardinal question of transportation as applied to the highway and the question of the taxation of the user of the highway. By reason of the fact that the growth of highway transportation has far outstripped the development of highway construction, it is today apparent that that construction will not carry the vehicle which is operating over it. At least, so claim the leading automotive authorities. The result is that the public has jumped to the conclusion that the cause of the destruction of highways is due to their use by heavy duty vehicles. That conclusion is not at all unnatural, in view of the fact that it is not based upon any investigation or upon any specific knowledge.

Now then, such investigations as have been made by different organizations throughout the United States, as well as by the U. S. Department of Public Roads under the Department of Agriculture, have clearly demonstrated that our highways are going to pieces, simply because they are constructed without reference to the bearing capacity of subsoil, drainage, or the construction of proper foundations. It is essential that this fact be brought to the public mind in order that its conclusion as to the cause of the disintegration of our improved highways may be based upon fact instead of upon surmise.

FOLLOWING the presentation of what passenger car designers have to say about their field, in our issue of January 1st, we give herewith a similar consensus of opinion with regard to that branch of the automotive industry concerned with the manufacture of trucks. It is plain enough that the problems confronting the truck designer are in many respects quite distinct from those with which the passenger car engineer is concerned. We have put some of these problems in questionnaire form before fifty leading designing engineers engaged in truck production, and the article on this page is our summary of the replies received.—THE EDITOR.

If the mind of the Legislature has determined that the heavy duty truck is the cause of breaking up of our improved highways, it is self-evident that it is going to legislate against the use of that truck. If, on the other hand, its opinion is based upon the facts as they really exist, if it has any elementary knowledge of the importance of transportation in this country in the distribution of its products, it will attempt to shape constructive legislation for the improvement of the highways.

The heavy duty motor truck is in the nature of a public utility and whether its use is justified or not is entirely dependent upon whether, as a transportation agency, it ultimately saves to the consumer dollars and cents in the cost of produce handled by it over the highways. This saving when analyzed will be found to be very material; if you will visualise for a moment the number of times that a spool of thread is handled over the highways, from the time the cotton, from which it is constructed, is grown, to the time when it is delivered to the ultimate consumer you will find that it has been handled considerably more than ten times, with the result that the saving of a very small fraction in the cost of hauling each time will very materially affect the competitive sales price of that article. In other words, the use of the motor truck, both in the handling of passengers and freight, is entirely an economic proposition for the benefit, according to the leading motor truck authorities, of the country at large. If that is so, there is no justification for limiting by legislation the use of the highway by that vehicle.

The motor truck fraternity in large part is therefore of the opinion that the trend of legislation should not be toward the enactment of new laws further restricting the use of the highways, but an intelligent survey of the purpose of highways and the enforcement of present laws as to their use. It is, too, of the opinion that the highway is of such material benefit to the general public that the cost of the construction of the highway should be borne by the public through general taxation. Again the authorities believe the user of the highway should pay for the maintenance of it, and therefore a tax on all users of the highway based as nearly theoretically as possible on their use of it should be enacted in order to maintain that highway in a condition which will carry the traffic which goes over it. These men do not believe that the motor vehicle is a subject for Federal taxation. It is not essentially a long-distance or inter-state carrier and it is already heavily taxed through personal property taxes, license fees, and special excise taxes.

Motor truck opinion, in general, is that the development of road legislation has conclusively demonstrated that the Federal Government should assist in the construction of important highways throughout the United States. It is particularly in favor of the Townsend Bill, which provides for a system of Federal highways constructed and maintained by the Federal Government. The experience of the industry has been that in order to effect any efficient solution of the highway problem it is necessary that the authority in reference to the highways in the various States be centralized in either a highway commissioner or a similar office in order that the State may control the development of its inter-county and main market highways along the lines of the development of Federal highways, whether constructed entirely through Federal funds or under the present method of Federal aid. The importance of the question of highway transportation has been disregarded in a remarkable manner when it is considered that all movements of produce in the course of their production from raw material to the finished products, start over the highway and finish over the highway. As a method of transportation incident to railroad transportation, and as a solution of the short haul problem, it far outranks in importance either waterways or railways.

The foregoing just about skims the subject of good roads and legislative measures toward that end. As many motor truck authorities have pointed out to us, entire volumes could be written on this phase of motor transport alone.

Engines to Fit the Fuels

Leaving the road question behind us, we come to the timely matter of engines and engine design, particularly as they pertain to the lower grades of gasoline now being handled. In general, motor truck builders are not doing as much with regard to meeting the lower grade fuels as the passenger car builders. This, in large measure, is due to the fact that many motor truck builders do not make their engines and other parts. The engines and carburetors are purchased from companies specializing in these products, and the motor truck builders are content to leave fuel problems in the hands of those concerned.

However, there is some development going on, nevertheless. Several motor truck builders are endeavoring to heat the gas being admitted to the cylinders by means of exhaust gas, the exhaust gas being controlled by a throttle. Others are installing a hot manifold on the engine so as to make the gasoline vapor more thoroughly combustible. One manufacturer is engaged in developing a satisfactory fuel for motor cars. A hot-spot manifold has been developed and is being used on at least one make of motor truck, which successfully handles one-half gasoline and one-half kerosene.

Whether or not we shall have to go to still lower grades of fuel is a controversial matter, with the decision seemingly with those who say we shall not, since we have perhaps already reached the lowest practical point. As long as there remains so little difference between the cost of gasoline and kerosene, or other similar low grade fuels, the public will not demand or put up with the inconveniences accompanying their use. But it is well to bear in mind that the situation in foreign markets is different. In some countries, the cost of gasoline is prohibitive, and motor cars and trucks are forced to operate on the low grade fuels, such as kerosene, benzol, alcohol, and so on. To meet these requirements, and also to secure better vaporization of the present-day gasoline, certain manufacturers use motors the inlet manifolds of which are properly jacketed by the hot exhaust gases, as already mentioned. At least one make of motor truck for this year is being equipped with a special carburetor of the so-called fuel converter type. This device itself burns part of the fuel in order to obtain the heat necessary to obtain proper vaporization of the fuel before it is introduced into the engine cylinders. This carburetor will burn any kind of mineral fuel having a gravity above 36 deg. Baume. Some one-, two-, and 3½-ton trucks equipped with this new carburetor were recently shipped to the Province of Viscaya, Spain, equipped for alcohol fuel. Though not as satisfactory as gasoline, they are reported to be doing very well in Spain, where it is possible to obtain high test alcohol at a price considerably below that of gasoline. Therefore, under certain conditions alcohol can now be used.

As in the passenger-car field, the gasoline type remains supreme and unassailable despite the many efforts along steam and electric lines. The steam and electric types have failed to meet the exacting conditions of highway transportation. The many handicaps of either of these types have not been overcome to a sufficient degree to warrant their replacing the tried and proved gasoline type. The electric truck has gained some adherents, true, but only for very short hauls and in city work. As a real competitor of the gasoline truck, it is negligible, at least so long as the present designs are followed out. It may be that at some distant date we shall see a vast improvement in electric vehicles, and certain fundamental disadvantages, such as the storage battery of limited capacity, will be overcome; but it is almost certain that in our day the gasoline truck will remain as the leading means of highway transportation.

Some Remarks About Bodies

The question of bodies is not the same with motor trucks as it is with passenger cars. In the latter case the bodies may be more or less standardized—and they are in the latest offerings; but with motor trucks a special body is required for almost every special kind of service. There is little opportunity for body standardization, since to standardize a body would tend to take away from the value of any given motor truck for the peculiar requirements of the user.

Thus there is less to say about bodies than we had hoped for. Still, our question has not been entirely barren of results. One manufacturer informs us that he furnishes 95 per cent of all his trucks with bodies built for the specific work to be done by said trucks, which seems a very commendable practice. The truck is made to fit the job, so to speak, instead of expecting the job to fit the truck. Others are also following out this practice in that they are endeavoring to take up individual body requirements of the users. While it is true that a standardized coal or [illegible] body may meet the general requirements of such service, there are bound to be cases where a special body will make a very material saving in the course of a [illegible], repaying many times the small additional cost [illegible] body especially built to fit the job.

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Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Finger-Nail Phonograph

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the communication of R. E. Sneyd in your periodical of November 27, regarding the "Finger-nail Phonograph," will say that any stiff bond paper may be made to act as a reproducer in a phonograph. One corner of the paper is placed in the groove; and then if the paper is bent a little so as to give it the right tension, the sounds may be heard faintly but distinctly, even when the ear is not in contact with the paper. If this contact is made, the sound is amplified, and I have made a very respectable reproducer by connecting a phonendoscope (one type of stethoscope) with a piece of stiff paper held in the groove of the record. I get best results with a piece of paper about two inches square.

Takoma Park, D. C. G. H. HEALD, M. D.

To the Editor of the SCIENTIFIC AMERICAN:

I notice a letter in your columns, re, the reproduction of music from a phonograph record with a finger nail. I would like to enlarge on this gentleman's remarks, having performed several experiments on this subject some years ago.

Any finger nail will give sound as long as it is long enough to reach into sound groove.

A needle held in fingers will play if finger nails of fingers holding same are at right angles to sound waves on record. A knitting needle held in teeth will sound very loud if teeth are held at right angles to sound waves. Also a small piece of tin soldered to a phonograph needle and held in fingers with needle held on record and tin left free with surface parallel to sound wave so that vibrations will cause tin to vibrate at right angles to surface will sound as loud as an ordinary reproducer without horn attached.

In fact any way in which the vibrations from record can be impressed on a solid body so as to cause it to vibrate with a certain amount of surface at right angles to vibrations will sound, the quantity of sound depending on size of same.

It never occurred to me that this matter ever needed explaining as it is so obvious when one considers the theory of sound recording and reproduction.

Red Deer, Alta. G. W. MARTIN.

To the Editor of the SCIENTIFIC AMERICAN:

The explanation of the "Finger-nail Phonograph" of which R. E. Sneyd writes in the November 27 issue of the SCIENTIFIC AMERICAN is very simple and involves no new principles. The sharpened tip of the finger nail acts as a needle, being vibrated by the impressions of the record, the remainder of the nail is forced into vibration and thus amplifies the sound. A needle held in the fingers makes a very faint sound or none at all for the reason that there is no means of amplification. If a needle is held in the fingers in contact with a piece of stiff paper, the paper will serve as an amplifier and a reproduction of the record may be heard which is even much plainer than that obtained with the finger nail

Oakland, Ia. ERNEST LINDER.

To the Editor of the SCIENTIFIC AMERICAN:

I noticed the letter from Mr. R. E. Sneyd in your issue of November 27, under the above caption.

I have tried several experiments with phonographic apparatus, and among them the two which Mr. Sneyd mentioned. Although I found the sound from the finger nail to be somewhat more distinct than from a phonograph needle held between the fingers, I could distinguish the melody quite readily in either case.

Mr. Sneyd suggested that perhaps an anatomist or scientist would explain these phenomena. I am only a high school student and do not profess any attainments in these lines, but if Mr. Sneyd will use for the same experiment a piece of metal or hard wood sharpened so as to be actuated by the undulations of the record groove, I think he will find the matter to be completely explained. The difference, I believe, is simply this: in the case of the phonograph needle there is a relatively small surface from which the [illegible] while the finger nail and [illegible] surface, but are [illegible] as well as communicating [illegible] the difference in the sound- [illegible] the question, [illegible] of sound is in almost every [illegible] of metal and similar substances.

Perhaps the action of the media in the above cases may be more readily understood by comparison with a similar case on a larger scale. If a phonograph needle is secured in the end of a shingle or any light, thin piece of wood, the whole may then be used in the same way as was Mr. Sneyd's finger nail. The result is almost perfect reproduction of the recorded waves, sometimes with as much clarity as with the machine-made reproducer.

I am a regular reader of the SCIENTIFIC AMERICAN, and I find many things in it which are very instructive as well as highly interesting

Fort Scott, Kan. DUDLEY M. WHITESIDE.

To the Editor of the SCIENTIFIC AMERICAN:

With reference to Mr. Sneyd's so-called discovery in regard to reproduction of phonographic vibrations, the writer wishes to take exception to the last statement made, namely, that no sound is heard if the needle is held in the fingers. A trial will convince one that the vibrations are produced fully as powerfully in this way as in the method cited, and by placing the ear against the hand the strain of music or enunciation of words may be detected. Further, if the needle be held between the teeth, the head and mouth cavity will act as resonator sufficiently to enable others to hear the reproduction, and this will be particularly clear to the experimenter on account of the transmission of the vibrations directly to the ear by the solid bones of the jaw. A. B. BINFORD.

Piqua, Ohio.

A Poetic Soul Breaks Loose

A Contributor on the Pacific Coast, whose interest was aroused by the recent reproduction in our columns of the Albuquerque reporter's noble efforts to tell his readers what the speaker had said about the make-up of the universe, sends us a gem of slightly different sort. This, so far as we can judge from the clipping, is a voluntary contribution by one of the subscribers of some very small-town weekly. He is so proud of his literary ability that he signs his name. If his excursion among the wonders of the world had operated to still his pen as well as his tongue, the world would indeed have been the poorer We reproduce his effusion faithfully

It is said the astronomer Homer sang and worshiped these same stars, and may not come we, every thirsty inquiring mind, let us venture into the realm of the velvet blue above what wealth what beauty is in store, see your beautiful evening star one of the most beautiful of the planets how I love to gaze upon her she bears me through infantude my imagination soars aloft. I have visited some of natures wonders of great views, have looked from top of Lookout Mountain on bottom of the great Atlantic through Mammoth Cave beneath the thundering Catarac of Niagara Falls which so filled me with wonder and admiration as to make me speechless. But all of these are tame compared to the revelations brought to me of the beauties of heaven at night through a telescope.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of November 27, Mr. Sneyd mentions the possibilities of obtaining a faint reproduction of a phonograph record through the use of the finger nail He states that an ordinary needle will not produce any sound. I have, however, reproduced records frequently with an ordinary needle or pin. While the resulting sound is very feeble, it may be materially increased if the pin is stuck through the corner of a small box, thus forming a sound box. If the box used is of tin, a fairly clear reproduction results, though of course with a rather metallic sound.

A READER.

Steam-Heated Gutters for Snow Removal

To the Editor of the SCIENTIFIC AMERICAN:

It is strange, in view of the mechanical genius of the age, that our cities are so helpless in a snow storm such as ordinarily may be expected any winter. The damage and loss and sickness and death in a great city are incalculable as the result of our still being limited to the archaic method of waiting till the storm is over then shoveling snow on to carts and dragging it to the dumps.

The writer offers the following suggestion conscious of deficiency in detail, but in the hope that it might be worked out experimentally on a small scale without too much expense

Sink in the gutters steam radiator pipes with an open drain. Perhaps the most serious problem would be to keep this open. A small drain will serve to carry off the snow water, as it melts, into the sewers Connect the radiator pipes with central steam generating plants as now operating At the very beginning of a snow storm, start street sweeping machines without a moment's delay, sweeping the snow as it falls. These assigned to proper areas should be able to keep up with the accumulation in brushing on to the steam-heated gutter whose small protected drain will carry the water into the sewer.

Every hour's work so will save days later If a high wage is demanded to work in the snow storm or at night, properly clothe and pay the men enough inducement. Heat applied to the snow from above radiates into the air and is wasted, but every unit is used when the conveyor of the heat is covered with the snow The live steam under the snow banks will soon run them off in water into the sewers

New York RALPH GODDARD

Cipher Literature

To the Editor of the SCIENTIFIC AMERICAN.

Can any of your readers tell me the name of any modern comprehensive work on the art of cipher writing and deciphering, or the name and dates of any magazine wherein articles on the art may be found? I am a novice in the art, but keenly interested in it, and perhaps some of the experts among your readers will be good enough to tell me how and where I may acquire some knowledge of the methods they use in deciphering. I noticed a number of letters on the subject in your correspondence columns during the war, but have noted an absence of all reference to it during the past year or two Perhaps some of your readers can inform me. BERNARD THOMSON.

169 Pender St, W
Vancouver, B. C

Jeweler vs. Jack-of-all-Trades

To the Editor of the SCIENTIFIC AMERICAN

A few months ago there appeared in your correspondence columns a letter telling of the putting of an open vial of kerosene in the case of a balky clock to improve its running, and later a letter from a clock maker, or repairer, ridiculing the idea as being of no value, and, if I remember aright, rather hauling you over the coals for allowing so unscientific a method to appear in your columns

The idea of putting kerosene in the case of a clock is very old, and it is undoubtedly good though it keeps many a dollar at home and out of the pockets of the clock repairer. I doubt if you could find many of the old wooden-case clocks without its open vial of kerosene

I have just gone the kerosene idea one better I have in my office a large wall clock which has refused to run for the past three years without its vial of kerosene Two months ago it stopped and no amount of coaxing would make it go It was impossible to take the clock down at that time for cleaning, so the kerosene was poured out and gasoline substituted and in five minutes' times it was running as well as it ever did

The writer has been a pretty constant reader of the SCIENTIFIC AMERICAN since 1866 and swears by it. I regret, however, to see the falling off in the number of "Queries" and your replies A READER

A Just Criticism

To the Editor of the SCIENTIFIC AMERICAN:

In the October 30th issue of the SCIENTIFIC AMERICAN you published an article, on the title page, on "The Rate of Speed at Which Bacteria Travel." On page 435 of your issue of October 23rd, in an article on "Painted Coffee," you say: "The paddles revolve at a high rate of speed," and in several other places recently I have noticed that you use the expression

Will you permit me to suggest that you abandon the term and substitute therefor "speed" or "velocity," either of which means rate of motion

If it means anything, "Rate of speed" means "Rate of the rate of motion," which I fancy is not what you intend to say.

WM E. GIBBS.

New York

Where Is Cleveland?

OWING to an oversight on the part of our contributor, we placed the paper on Alcohol Obtained from Coke Oven Gases, noticed in our issue of August 21st last, with the Cleveland (Ohio) Institution of Engineers, instead of with the organization of that name in Cleveland, England, where it was actually read.

X-Ray Tubes by the Hundreds

How the Trained Mechanic and the Skilled Glassblower Have Been Replaced by Automatic Machinery

By George Gaulois

QUANTITY production has become so commonplace of late that it is the rule rather than the exception in many industries. The manufacture of thousands upon thousands of parts in various metals and their assembly into hundreds upon hundreds of finished machines is a remarkable undertaking, true; but the process is merely an elaboration upon the usual lathe, drill-press, boring mill, and planer, coupled with the systematic routing of the materials and parts through the factory

In the manufacture of X-ray tubes the work must of necessity be of the most delicate and exacting sort Indeed, heretofore X-ray tubes have been produced by the most painstaking handwork, one at a time, to meet the steadily-increasing demand The metallic electrodes and accessories have called for the finest kind of machine work—some details being quite comparable to watchmaking—while the glasswork has required the skill of an expert glassblower Little wonder, then, that most of the world's X-ray tubes came out of Germany and France during pre-war days, where skilled workmen still continue to practice their handiwork in much the same painstaking manner as their predecessors of the medieval trade guilds

How, then, could quantity production methods be applied to the manufacture of X-ray tubes? Of course, the automatic machinery in general use might well be put to work on some of the simpler metal parts of the tubes, but how about the delicate glassware? How could anything take the place of the glassblower's carefully controlled blow-torch and deft hands? To be sure, it would seem that X-ray tubes were intended to remain a hand-made product

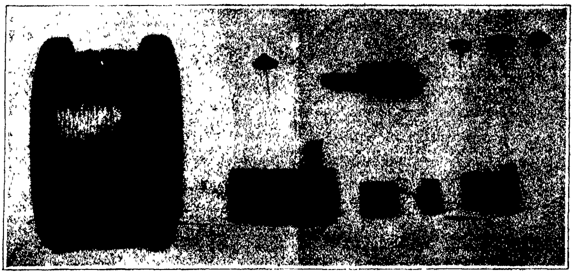
The demand for X-ray tubes has increased by leaps and bounds. Whereas but a few years ago X-ray outfits were to be found only in the leading hospitals and in the hands of X-ray specialists, today there are outfits in the hands of many dentists, doctors, research laboratories, manufacturing plants, schools, and other institutions. X-rays are no longer confined to medical and surgical uses; industry has found more than one way of employing X-rays in examining materials for hidden flaws. Obviously, the tubes have fallen into the hands of persons possessing little if any technical training in electricity, hence it has been necessary to produce a simple and uniform X-ray tube which could be handled with almost the same facility as the ordinary electric bulb.

It has remained for one of our foremost electric companies to develop a quantity production system for manufacturing X-ray tubes. At the present writing that organization is turning out over one hundred tubes every working day—one hundred tubes or more of excellent and uniform quality. The tubes are of the Coolidge universal and radiator types, and the process of manufacture may be divided into the following stages: 1. Preparation of the metal parts. 2. Assembly of the X-ray tube. 3. Exhaust of the assembled tube. 4. Testing of the finished tube.

Now tungsten is one of the essential metals entering into the construction of the anode and cathode of the Coolidge tubes The complicated process required for the production of this metal was evolved in connection with the incandescent lamp development, and a complete description of this interesting process will be found on page 130 of the SCIENTIFIC AMERICAN dated August 7, 1920.

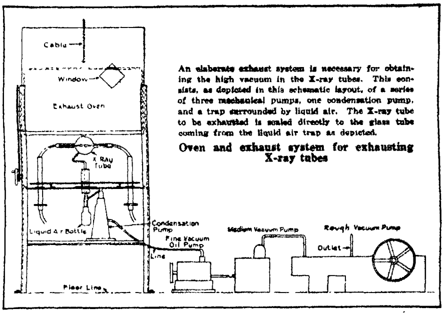
Tungsten cannot be worked mechanically while cold. It is so hard that it cannot be machined by sharp-edged tools, but has to be brought into desired shapes by high temperature hammering or cold

(Continued on page 88)



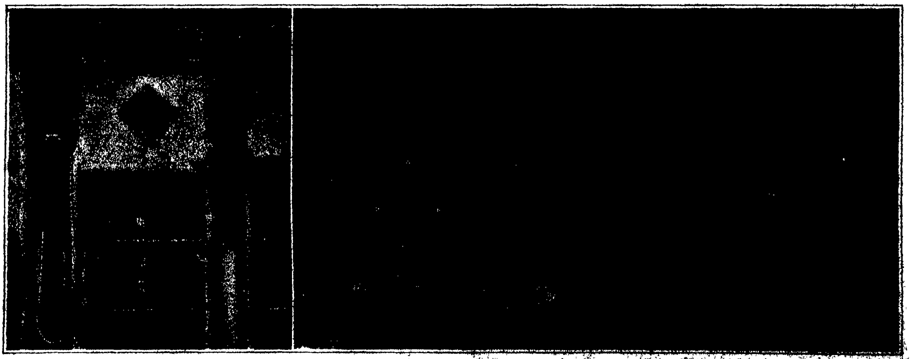
At the left appears the spool of tungsten wire. At the right, above, is shown the mandrel with filament wound on it. The pieces below show the form (unassembled) for the high firing of the filament. The three articles in the upper right-hand corner are, respectively, a fine focus filament after firing in form, a medium focus filament, and a broad focus filament

Various steps in the forming of filaments for cathodes



An elaborate exhaust system is necessary for obtaining the high vacuum in the X-ray tubes. This consists, as depicted in this schematic layout, of a series of three mechanical pumps, one condensation pump, and a trap surrounded by liquid air. The X-ray tube to be exhausted is sealed directly to the glass tube coming from the liquid air trap as depicted.

Oven and exhaust system for exhausting X-ray tubes



Left: Exhaust oven for the universal type of tube with the tube in position. *Right:* Electric vacuum furnace used for firing metal parts of the X-ray tubes.

Speaking of Scaffolding—

WITH the shortage of office space in New York City during the past few years, New Yorkers have engaged extensively in changing over existing buildings so as to get the most space and the greatest efficiency from them. A case in point is one of New York's oldest office buildings. This building was recently bought by a shipping concern and work begun to remodel it both inside and outside. During this work the building has been covered with a mass of scaffolding to accommodate the stone-cutters, bricklayers and others, as shown in our photograph.

Copyright Keystone View Co.

Overhauling one of New York's oldest office buildings: a study in modern scaffolding

Getting the Candlepower Reading from All Angles

USED during the war in measuring the distributing power of flashlights, an apparatus designed by the United States Bureau of Standards has been adapted to uses of measuring light distribution of lamps. The instrument can be employed in taking the candle-power from any angle—a radical improvement over the older type of photometer which recorded the lighting strength only from a horizontal position.

As can be observed from an examination of the photograph, mirrors serve utility purposes other than reflecting the facial expression posed in Milady's boudoir The series of mirrors in suspension, shown in the background, reflect light to the portable photometer in the foreground of the illustration. A graduated circle shows the angle at which the readings are taken From the photometric values at varying angles the distribution curve may be constructed.

This design of distribution photometer is capable of measuring the light distribution of all kinds of units, the candlepower being registered from any angle. Any kind of lighting measurement can be calculated.

A collection of mirrors serves to reflect the light on to the photometer at the left, thus indicating candlepower from any angle

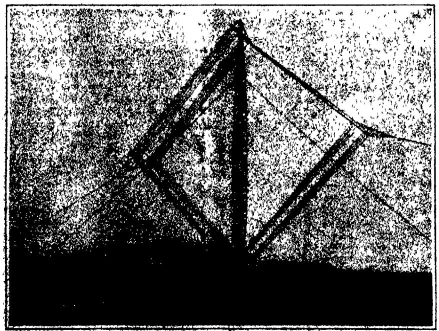
The Superlative in Loop Antennae

SPEAKING before a distinguished gathering at the recent opening of an inter-city radio communication service between New York, Cleveland, Detroit and Chicago, Dr. Lee DeForest, the radio pioneer and inventor, brought out the fact that where such an enterprise had failed fifteen years ago, it would succeed today.

The difference between both attempts is one of relative technical knowledge and equipment. Fifteen years have made a vast difference in radio communication Fifteen years ago the transmitters were crude and inefficient, propagating in the form of wireless waves but a small part of the energy put into the transmitter. Yet the greatest handicap was in the receiving apparatus which, without the present-day ultra-sensitive detectors and the remarkable amplifiers, were unable to weed out undesirable signals and nearby interference without weeding out the desired signals at the same time. Weeding out, in the radio sense, means the process of elimination carried out until only the desired signals remain. But unless they are sufficiently powerful to begin with, or very sharply defined in wave length so as not to conflict with undesirable signals, or, again, unless there is some means of amplifying or building up the almost infinitesimal and generally inaudible impulses that sift through the weeding-out circuits, the weeding-out enterprise is doomed to failure.

Thanks to the introduction of Dr. DeForest's audion, or three-element vacuum tube, radio communication for inter-city communication and for other applications where there is a great deal of interference due to a large number of stations working in a limited area, is now feasible from a technical standpoint. Furthermore, loop antennae may be used in place of lofty aerials, at least for receiving purposes, and such loops, because of their directive properties, further strengthen the desired signals by weakening or eliminating the undesired signals. The loops are now used to a considerable extent because they eliminate static or atmospheric disturbances, thus making radio communication far more reliable than heretofore The vacuum-tube amplifiers permit the slight currents induced in the loops to be amplified to such degree as to be altogether audible.

It appears that Germany has been conducting extensive experiments with loop attennae, the loop shown in the accompanying illustration being probably the largest in present use It measures well over 130 feet in diameter, and is supported by a single lattice mast. From the meager reports filtering through to us, it appears that this loop is being used in experimenting with inter-city communication, in which case it is desirable to direct both the transmitting and receiving antennae in order to reduce interference to a minimum and to concentrate, instead of spread, the wireless waves.



A giant loop antenna measuring 130 feet across, used in Germany for inter-city communication tests

Important Swiss Discovery Affecting Watchmaking

A DISCOVERY that is reported by the press as being capable of revolutionizing the watchmaking industry has just been announced by Mr. C E Guillaume, director of the International Bureau of Weights and Measures A successful method of regulation, remedying the variations in time of a watch due to the expansion and contraction of its parts caused by variations of temperature, is the result of Mr Guillaume's invention This so-called "secondary error" has always been one of the great obstacles in the attainment of perfection and precision in the watchmaking industry, and if this difficulty is overcome the watchmaking industry should receive very considerable impetus, owing principally to the simplifying of the process of regulation

The chief feature of Mr. Guillaume's new process is a change in the alloy used in the compensating parts The minimum expansion of nickel steel was found to be increased by the addition of 12 per cent of chrome as well as a very small quantity of tungsten, manganese, or carbon By mounting a spiral of this steel-nickel-chrome alloy in the watch, according to Mr. Guillaume's announcement, the problem of compensation has been solved and the "secondary error" removed.

Extension of Air Service Between the Netherlands and Great Britain

ANNOUNCEMENT is made that the airplane mail and passenger service which has been operating daily between the Netherlands and Great Britain since May, 1920, has been extended so as to include a daily service to Denmark and Sweden by way of Germany Under the new arrangement, which went into effect September 15, passengers and mails can leave London either by way of Croydon, at 10 A. M., or by way of Cricklewood, at 4 P M, and reach Amsterdam that evening. From Amsterdam the journey is continued at 8:50 A. M. the next day, with stops at Bremen at 11:30 A. M., Hamburg at 1 P M, and at Copenhagen at 3.30 P M A branch or supplementary service leaves Bremen in time to reach Berlin at 3.30 P. M By this service the trip from London to Copenhagen is advertised to be made in 24 hours, as compared with 40 hours by steamer or rail and steamer. Owing to the early approach of winter in this latitude, it is regarded as impracticable to attempt to make the trip in one day at the present time, but it is planned to accelerate the service next spring

The entire service for passengers and mail between points in the Netherlands and London and elsewhere has been more or less experimental during the whole of the past season The plans of the company operating the machines include the organization of a network of services all over this part of Europe, and the service so far given has been more or less in the nature of an attempt to find out what routes are commercially and otherwise practicable. The service between the Netherlands and England has been carried on without a single interruption and with increasing success The service from Holland to Great Britain carries more passengers than freight, whereas that from England to Holland carries more freight than passengers

The mail service to Great Britain averages about 480 letters per day, letters for the service simply being marked for the air post and double postage paid.

Left: An excellent example of the modern four-speed gearbox and multiple-disk clutch assembly suitable for unit-power-plant installations. *Center:* A typical dual-reduction axle design, showing the components *Right:* An external constricting shoe brake.

Some of the features of the 1921 motor truck, which account for the growing list of motor truck users

The Trend of Motor Truck Design for 1921

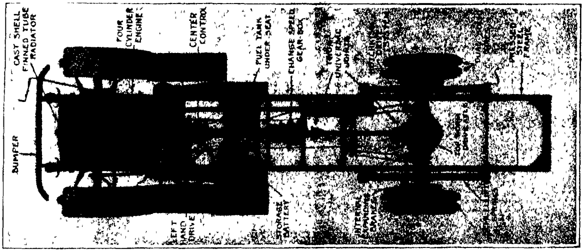
A Brief Survey of the Features Displayed by Six Hundred and Eighty-two American Models

By Victor W. Pagé, M.S.A.E.

IN analyzing motor truck specifications in an effort to determine the trend of engineering practice there are two ways of considering the various truck designs One of these is by taking the total production of trucks, the other and fairer means, in the writer's opinion, is to consider the number of distinct truck models apart from the numbers in which any one make of truck is produced In considering truck-design progress upon the former premise one will find a number of things that are not at all true when considered from the other point of view

For example, there are very large numbers of light motor trucks and "speed wagons" produced in which spiral-bevel driving gearing is used yet when considering the total number of distinct models offered, the spiral-bevel drive gearing is found to be a very small percentage of the final drive system favored by truck designers If one considered merely the quantities of trucks manufactured as a criterion for basing opinions on the progress of design it would be seen that the planetary transmission system and transverse front and rear springing were used on a large number of trucks, though all of these would be of one make The same thing applies to internal gear drive axles. If one considers total production it is found that this method of final drive is used on a large proportion of motor trucks built in this country If one considers the subject from the number of distinct models of trucks offered, bearing in mind that each of these represents some individual designer's preference, we find that the larger percentage of models favors the worm gear drive

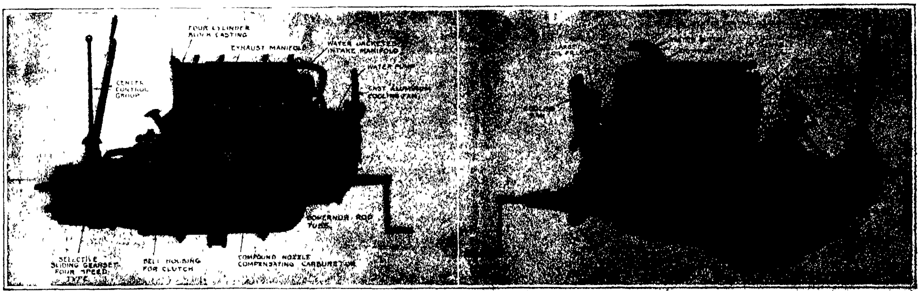
In order to determine the trend of modern practice with some degree of accuracy the writer went over the advance specifications of 682 truck models, ranging in capacity from 1,000 to 15,000 pounds. The conclusions arrived at are given in a general manner without computing percentages, as it is believed that the readers of this publication are more interested in a plain discussion of the trend of modern practice than they are in an engineering discussion supported by more or less accurate percentage values that may be open to question according to the way they are interpreted by the individual This interpretation in turn is often guided or formed by personal prejudice in favor of some one form of construction



Plan view of typical modern motor truck chassis of latest design, showing Hotchkiss drive system, semi-elliptic spring suspension, internal expanding brakes, and pressed steel frame

Considering first the classification of models available according to load rating we find that the 1½-ton truck is the most popular inasmuch as 127 distinct models of this capacity are available. The next most popular size is the 2½-ton truck with 108 models and a close third is the 2-ton or 4,000-pound class with 107 models offered There is so little difference between these two classes that one may safely say they are equally popular. Ninety-seven models of 3½-ton capacity are offered and, strange to say, there are as many as 75 distinct models of 5-ton trucks. The 1-ton truck is marketed in 68 distinct models; there are only 6 commercial vehicles rated at 1,000 pounds capacity or less; and 23 models ranging from 1,000 to 1,500 pounds capacity. Certain makes of these, however, are produced in very large quantities so that trucks of 1-ton capacity or less are probably produced in larger numbers than any other class.

There is a commendable tendency to depart from odd or fractional ratings because these are apt to prove confusing to the truck purchaser. No truck is ever loaded just to capacity, and as a matter of fact most trucks are *overloaded*; so there is nothing to be gained in having some truck classes that differ by only 500 pounds from others. To show how few the models are of such intermediate capacities between the main classification heads we


FOUR CYLINDER BLOCK CASTING
EXHAUST MANIFOLD
WATER JACKETED INTAKE MANIFOLD
WATER PUMP
CAST ALUMINUM COOLING FAN
CENTER CONTROL GROUP
GOVERNOR ROD TUBE
SELECTIVE SLIDING GEARSET FOUR SPEED TYPE
BELL HOUSING FOR CLUTCH
COMPOUND NOZZLE COMPENSATING CARBURETOR

Left: Latest type of unit power plant for motor truck includes a four-speed selective gearset and multiple disk clutch. *Right:* Four-cylinder dual valve motor truck engine with detachable head and clutch housed in motor bell housing Note the clean cut and compact appearance of this power plant, which is typical of modern motor truck engineering practice.

Typical motor truck engines, gearset and clutch units, showing the development along simpler and more compact lines and but six models rated at 2,500 pounds and two at 3,500. The truck purchaser who is in the market for a 3-ton truck may make his selection from 24 distinct models while those in need of 4-ton trucks have 17 models to choose from. Considering capacities over 5 tons, one finds specifications for 3 of 11,000-pound capacity, 7 of 6 tons, but one model of 6½ tons, 6 models of 7 tons and 2 of 7½.

The next point to consider is the engine power provided for the various models and while there is considerable diversity and at first glance no uniformity of opinion among the various designers as to the best horse-power for a given capacity, a more careful analysis of the specifications enables one to divide practically all of the engines used into five classes. In the trucks ranging from 1,000 to 2,500 pounds capacity, inclusive, one finds that engines approximating 22.5 horse-power are the most popular. Most of the trucks in the 3,000 and 3,500 pound classes have engines rated at 25.6 horse-power. Power plants having an average rating of 27.2 horse-power are found in trucks ranging in capacity from 2 tons to 2½ tons, though many of these have engines rated as low as 22.5 horse-power and a few in excess of 32 horse-power. In the 3-ton class the most popular engine rating seems to be 28.9 horse-power though even in this classification one finds a few engines of 22.5 horse-power. The highest engine rating in the 3-ton class is 42.8 horse-power. Trucks ranging in capacity from 7,000 to 8,000 pounds seem to require an average of 32.4 horse-power though some of these are provided with engines rated as low as 25.6 horse-power while other designers seem to think that 36 to 42.8 horse-power engines are necessary to carry the load satisfactorily. In trucks of 4-ton capacity and over, the most popular engine rating is 36 horse-power.

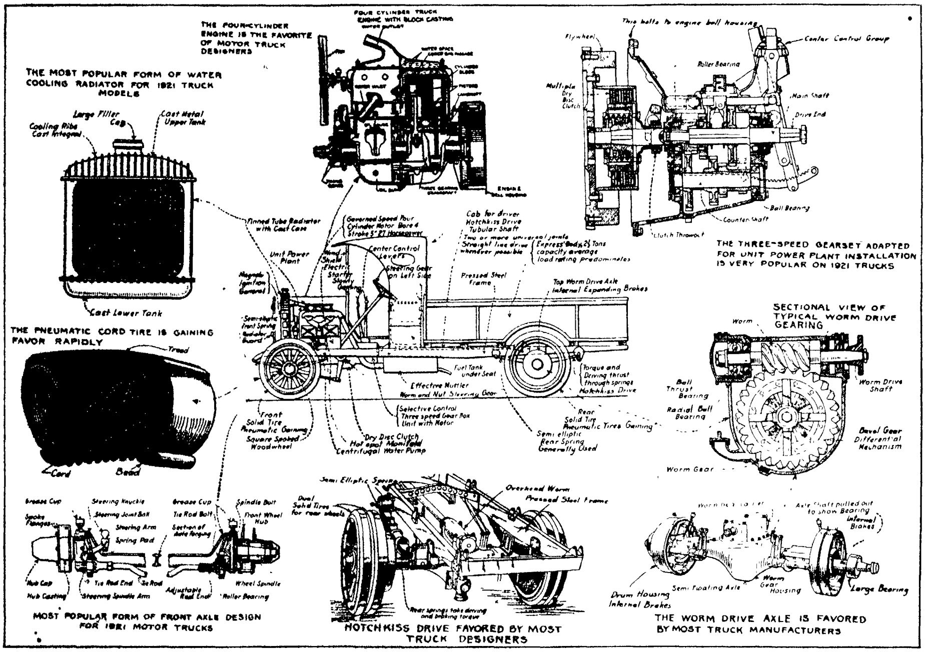
There are many factors which enter into determining the amount of power required for a truck of given capacity, among which may be mentioned the method of final drive and the road speed desired. The type of change-speed gear-box and whether it has three or four speeds and whether or not the truck is intended to be used with pneumatic tires must also enter into consideration. As the carrying capacity of the truck increases it is good engineering practice to reduce the maximum speed with increasing truck weight. The reason for this is obvious. The momentum that would be acquired by a heavy truck traveling at high speed would make it extremely difficult to control, and it would not only be dangerous in traffic but it would be far from economical to operate on account of the large engine demanded. Besides, the depreciation of our highways, which even now are not built with an adequate conception of what they must be able to resist when subjected to motor traffic, would be so great that legislation would be necessary to curb truck speeds. When heavy trucks travel at low speed it is possible to use engines of comparatively low horse-power ratings because the power is utilized in an efficient manner and the engine runs more nearly at a constant speed than when the speed range is greater and more power is provided than is necessary for the majority of operating conditions.

Practically all motor trucks, regardless of load rating, are equipped with four-cylinder power plants, and nearly all trucks of over one-ton capacity have automatically-governed engines. The popularity of the four-cylinder motor for truck use and the unanimity of opinion on the part of truck designers regarding the best type of power plant can be well understood when it is stated that of the 682 specifications analyzed, the writer found but two trucks equipped with six-cylinder engines and but two with eight cylinders. The only good reason for using engines of more than four cylinders in motor trucks that the writer can advance is that the designer wanted to use something different from what the consensus of contemporary opinion indicated as desirable, in order to provide his salesmen with a few new talking points. One familiar with trucks knows that the type of engine that is the most suited for passenger car propulsion is not the best type for motor truck use. The motor truck is a commercial proposition and demands a power plant of maximum simplicity, reliability and economy. The four-cylinder engine incorporates all these features to the highest degree. There is but one make of truck that is sold to any extent that uses an engine of less than four cylinders but this one is produced in fairly large quantities and its two-cylinder opposed horizontal-type motor has given such good service for a long term of years that the makers have not considered it necessary or desirable to provide a different engine.

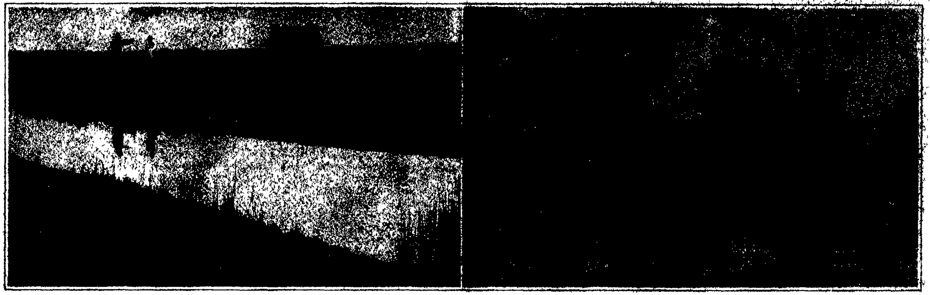
Practically all commercial vehicles are provided with water-cooled engines, there being only two makes fitted with air-cooled engines, one of these being an unconventional two-stroke cycle engine produced in very small quantities while the other is a brand new offering of a well-known air-cooled passenger car maker who has brought out a light delivery truck equipped with the same type of engine used in his passenger-carrying vehicles. Forced water circulation by means of positively driven circulating pumps is most generally applied though the thermo-syphon or natural system of water-cooling seems to be gaining in popularity, especially on trucks of less than 2-ton capacity. The lubrication systems of practically all engines operate on the combined force feed and splash principle in which oil is drawn from a sump at the base of the engine by a pump and forced to the main bearings and, in some cases, through a hollow crankshaft to the connecting-rod end-bearings. The surplus oil flows to troughs in the engine base, into which splashers attached to the lower ends of the connecting rods dip at each revolution of the crank, distributing the oil in the form of a spray or mist, to all points of the engine interior such as the camshaft and its bearings, the cams and valve lifters, the wrist pins and the piston and cylinder walls.

Water-cooling is by tubular radiators having finned, cast-metal upper and lower tanks and a cast-metal

(Continued on page 38)


THE FOUR-CYLINDER ENGINE IS THE FAVORITE OF MOTOR TRUCK DESIGNERS
FOUR CYLINDER TRUCK ENGINE WITH BLOCK CASTING
ENGINE & BELL HOUSING
THE MOST POPULAR FORM OF WATER COOLING RADIATOR FOR 1921 TRUCK MODELS
Large Filler Cap
Cast Metal Upper Tank
Cooling Ribs Cast Integral
Cast Lower Tank
THE PNEUMATIC CORD TIRE IS GAINING FAVOR RAPIDLY
Tread
Cord
Bead
Finned Tube Radiator with Cast Case
Unit Power Plant
Magneto Ignition General
Semi-elliptic front Spring
Radiator Guard
Governed Speed Four Cylinder Motor Bore 4 Stroke 5" 27 Horsepower
Wind Shield
Electric Starter
Center Control Levers
Steering Gear on Left Side
Cab for driver
Hotchkiss Drive Tubular Shaft
Two or more universal joints
Straight line drive whenever possible
Express Body 2½ Tons capacity average load rating predominates
Pressed Steel Frame
Top Worm Drive Axle Internal Expanding Brakes
Fuel Tank under Seat
Effective Muffler
Worm and Nut Steering Gear
Torque and Driving thrust through springs
Hotchkiss Drive
Front Solid Tire Pneumatic Gaining
Square Spoked Woodwheel
Selective Control Three speed Gear Box Unit with Motor
Dry Disc Clutch
Hot spot Manifold
Centrifugal Water Pump
Rear Solid Tire Pneumatic Tires Gaining
Semi elliptic Rear Spring Generally Used
This bolts to engine bell housing
Flywheel
Center Control Group
Roller Bearing
Multiple Dry Disc Clutch
Main Shaft
Drive End
Ball Bearing
Counter Shaft
Clutch Throwout
THE THREE-SPEED GEARSET ADAPTED FOR UNIT POWER PLANT INSTALLATION IS VERY POPULAR ON 1921 TRUCKS
SECTIONAL VIEW OF TYPICAL WORM DRIVE GEARING
Worm
Ball Thrust Bearing
Radial Ball Bearing
Worm Drive Shaft
Bevel Gear Differential Mechanism
Worm Gear
Grease Cup
Steering Knuckle
Spoke Flanges
Steering Joint Ball
Steering Arm
Spring Pad
Tie Rod Bolt
Section of axle forging
Spindle Bolt
Front Wheel Hub
Hub Cap
Hub Casting
Tie Rod End
Tie Rod
Steering Spindle Arm
Adjustable Rod End
Wheel Spindle
Roller Bearing
MOST POPULAR FORM OF FRONT AXLE DESIGN FOR 1921 MOTOR TRUCKS
Semi Elliptic Spring
Dual Solid Tires for rear wheels
Overhead Worm
Pressed Steel Frame
Rear springs take driving and braking torque
HOTCHKISS DRIVE FAVORED BY MOST TRUCK DESIGNERS
Axle Shaft pulled out to show Bearing
Internal Brakes
Drum Housing Internal Brakes
Semi Floating Axle
Worm Gear Housing
Large Bearing
THE WORM DRIVE AXLE IS FAVORED BY MOST TRUCK MANUFACTURERS

The composite truck for 1921, together with its distinguishing characteristics



Before and after reclamation. The same homestead on the Umatilla Project, Oregon, in 1909 and in 1914

Something for Nothing

A Combination of Engineering, Water and Land That Makes Wealth

By C. H. Claudy

TO one part of science add two parts of engineering, stir in some partisan politics, add the pinch of the high cost of living—and get this story. It seems a queer mixture. Yet science, engineering, politics and the high cost of living have a common meeting ground in a subject of real importance to all Americans and of vital importance to half a million of us—that subject being the reclamation of waste land by water.

The average price obtained from the products of all the acreage under cultivation in the United States last year was something less than $17 per acre. The average price obtained from the products of all the irrigated acreage in reclamation projects under cultivation in the United States last year was in excess of $80 per acre.

Prior to the establishment of these reclamation projects, the average yield from the acres now irrigated was exactly $0.00. Indeed those acres were a real expense to Uncle Sam, since they then paid no taxes, produced no crops, fed no people, provided homes for none. Be it noted also that the acreage available under existing projects is not yet working to its maximum capacity. Crops worth $88,609,969 were taken from 1,108,500 acres in reclamation projects in 1919; but 1,177,210 acres were irrigated in that year and 1,033,759 are irrigable under existing water supplies as developed by the reclamation engineers. In other words, reclaimed lands were only sixty-eight per cent cropped in 1919, and the 88½ millions would have been 130 millions had all the irrigable areas been cropped.

But the entire expense of the whole reclamation system from its very first beginning in 1902 to the end of June 1920, has been but $123,178,779.77!

He who runs and reads will not need to have it pointed out very definitely that if the United States had borne the entire cost from the public pocket, reclamation would be a paying investment. A farmer who invests ten thousand dollars in equipping a farm and gets back his entire outlay in two years with a big profit is more than satisfied. The United States has invested one hundred and twenty-four millions in reclamation and reclaimed acres brought back eighty-eight millions in one year. The total crop value from reclaimed lands, for all years since the service started, is greater than a quarter of a billion dollars. Would any sane man refuse to invest a dollar to get back two?

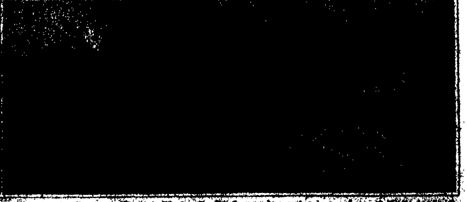
But this is but the beginning of the story. If one allows $10 an acre as the value before irrigation of all lands under irrigation now, the total pre-irrigation value of the land is not quite eighteen millions of dollars. And it was public land, non-taxpaying. The total value of land in the projects, cities, town and villages within projects, and created by the projects, is today nearly six hundred millions of dollars.

To spend 124 millions and reap 600 millions in property, besides 250 millions in income, would seem a reasonable gamble to almost any speculator, even if the speculation was eighteen years long. But when the fact that the United States is not paying for reclamation is brought into the discussion the matter takes on a very different complexion. Reclamation is not a gift of the American people to the half a million of them directly benefiting under it. Farmers who take up reclaimed land pay for it, and the payment includes the cost of all the irrigation from which the land benefits. The total cost of a project is divided by the number of acres to benefit from that project and the farmer pays the bill. True, he doesn't have to pay it all at once or quickly; the United States requires five per cent on taking possession as a guarantee of good faith, after which the farmer has five years to get himself financially independent and fifteen years more to pay the balance. But the point is that the money spent comes back, and is spent again, and again comes back.

The reclamation fund is a revolving fund and should work in perpetuity (or until all irrigable land is irrigated).

Here is the point. The fund isn't big enough to enable reclamation work to be done as fast as the public, the high cost of living and the need for greater good-crop acreage demands. It is here that politics raises its head and peers over the horizon.

(Continued on page 40)



1. Arrowrock Dam, Boise Project, Idaho; the highest dam in the world (351 feet). 2. Irrigated scene on the Okanogan Project, Wash. 3. Ditch carrying water to a colony of [illegible] [illegible] on the Orland Project, Wash.

Mechanical aspects of reclamation, and a suggestion of its results

When the Pony Hauls the Airplane

INGENUITY seems at its best when it thrives at a summer resort. For nowhere else does one find so many simple yet unusual ideas put to work to earn a handsome income for their originators.

Thus some bright young man hit upon the idea of the pony cart fashioned like an airplane, as shown in the accompanying view. Fifteen of these carts were constructed and put into operation at Atlantic City, N. J., in order to extract money from fond parents who have neither the heart nor the inclination to deny every little whim of their persistent offspring. The pony airplane cart is reported to be a real business success.

Fifteen of these odd airplane pony carts are earning big returns for the man who conceived this simple yet unusual idea

A Gold Mine in a Garage

SOME time ago while excavating for a large underground gasoline tank at the Grass Valley Garage, Nevada County, California, Mr. A. B. Snyder, the owner, uncovered a well-defined ledge of gold quartz at a depth of six feet. Mr. Snyder decided to do some mining inside of his garage. A windlass was installed and a shaft sunk, and in a short time some beautiful gold specimens were extracted from below the garage floor. The shaft was sunk to a depth of sixty feet, and so much water was encountered that an electric pump was installed in the shaft to keep the water out.

During the mining operations several tons of gold quartz were taken out of the shaft and drifts under the garage. This was crushed and milled in a nearby stampmill. The quartz gave returns of $137.50 per ton.

After working the mine for a short time the waste dirt taken out accumulated in a large pile which extended the full length of the floor inside the building, leaving little room for automobiles. Mr. Snyder decided he had mined enough and shut down. A local gold-mining company then purchased the mineral rights under the garage and are now working the ledge through their mine. Because of its discovery in the Grass Valley Garage, the ledge is known to mining men as the "Garage Ledge."

A sixty-foot shaft was sunk down below this garage floor in order to mine a ledge of gold quartz

The Miniature Automobile — An Odd Use for Airplane Parts

AN excellent little racing car can be made from a collection of odds and ends, as proved by the diminutive racer owned by Mr. Robert Breese of New York City. This little racer has attracted no end of attention wherever it has been shown.

It appears that Mr. Breese constructed his little racer while stationed at one of the Army flying fields. A discarded motorcycle twin-cylinder engine, four airplane wheels and tires, an airplane windshield, and a collection of other miscellaneous airplane and motorcycle parts found their way into this unique racer. That the racer is something more than a toy is evinced by the fact that Mr. Breese has been using it steadily for the past two years. The little car makes close on to 50 miles per hour, and because of its low center of gravity there is virtually no danger of spilling. So the driver takes pleasure in furnishing his audience with thrills by turning corners at a high rate of speed, with a resultant side slip which would mean almost certain disaster to the usual racing cars operating under similar conditions.

Many automobile, airplane and motorcycle parts found their way into this diminutive racer

A Theater to Order

THE notion of a great public pageant involving a performance of some composition either written expressly for the occasion or selected from the classics because of its appropriateness is not particularly novel, but when it was decided to give Verdi's great opera "Aida" in Milan on this scale the project called for something rather more ambitious than such a scheme usually involves. The fact of the matter was, there was no suitable location for the performance in existence, so the management of the spectacle was obliged to undertake the construction of one. It was decided that anything worth doing at all was worth doing well, and that a permanent open-air theater of imposing proportions was the only thing that would really justify the effort. So we have the rather unusual feature of such an arena being built to order for a single occasion—none the less built to order through the fact that it will remain standing and serve for general purposes after its special mission is discharged. We are not informed as to its dimensions, but the view herewith indicates very clearly that it is of most respectable proportions.

The open-air theatre at Milan, constructed especially for a commemoration performance of "Aida"

Transforming Explosives Into Fertilizers

MANY standard explosives contain large amounts of nitrogen especially in the form of nitrate of ammonia. The Italian Government some time ago requested Professor F. Garelli of Turin to undertake experiments with a view to transforming such explosives into harmless fertilizers, suitable for delivery to agriculturists. Nitrate of ammonia is very soluble in water. Professor Garelli, therefore, added a definite quantity of water to the explosives and allowed the mixture to settle in special basins. He thus obtained a dense solution of nitrate of ammonia readily separated by decantation. With this solution he then mixed powdered peat, the mixture being easily and rapidly dried. He thus obtained a fertilizer which he calls "nitrated peat" which has the following composition: water 17.8 per cent, ash 18.8 per cent, nitrate of ammonia 42.8 per cent, organic matter 20.6 per cent.

The fertilizer is a dark powder containing 10.4 per cent of nitrogen (7.5 per cent in the nitric form, 7.5 per cent in the form of ammonia and 1.4 per cent of organic nitrogen), plus 0.06 per cent of phosphoric anhydride and 1.8 per cent of potash. As will be seen its composition is analogous, therefore, to that of the nitrate of soda, which it can be used to replace in agriculture.

The fertilizing value of this nitrated peat was carefully determined by practical experiments made by Professor Gamacchio, director of the Provincial Chair of Agriculture at the University of Turin. The results of his tests in the district of Alba indicate that this new fertilizer is approximately equal in operation to nitrate of soda.

A Notable Experiment in Afforestation

A MOST interesting experiment in afforestation has been successfully tried out during the last quarter of a century by Senor Francisco Piria, a prominent citizen of Montevideo, Uruguay, to the south of us.

Having noted during a trip to Australia and Tasmania the great value of the Eucalyptus tree in its various species, not only for quick growth timber and fuel, but for stately ornament and aromatic shade and to diminish drought, the Senor determined to try them on a large scale in his own country. He bought about a million young trees, which he set out on a tract of barren land at a spot on the South Atlantic coast about fifty miles east of Montevideo. These were planted on the beach, in the sand, in a place that was not forest land at all.

The young trees took hold and thrived amazingly well, others were added, and at the present time there are something over three million trees, chiefly eucalyptus, in the plantation. The Senor figures that these trees, as fuel merely, increase in value at the rate of fifty cents gold per tree per year, that is about a million and a half dollars increase in the value of his tree investments each year.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

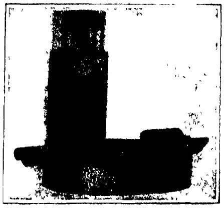
Slot machine for calling a taxi

Calling a Cab by Slot Machine

WE are quite accustomed to purchasing our chewing gum from a vending machine, the automatic restaurant has introduced us to an unexpected variety of mechanical peddlers of liquid as well as of solid food, it is not even a totally new experience to many of us to buy a newspaper from an automaton or pay our street car fare to such a device The pay-station telephone has been on a slot machine basis in many of our cities for a long time now, and even when we put in a call for the fire apparatus we apply the slot machine principle, divorced from the actual presence of a slot It is as yet reserved to the dwellers in the German city of Hamburg, however, to exercise the privilege of calling the taxicab by use of a slot machine Our illustration shows how it is done and what the machine looks like You simply drop a coin in the slot and presently the desired taxi arrives on the spot Whether your coin is deducted from your fare does not appear—it might reasonably be pleaded that it is worth a little extra to have the taxi wherever you may happen to be

A Cigarette Tray with a Snuffer

CIGARETTE trays are now provided with snuffers for putting out smoldering cigarettes After the smoker has finished his smoke it is pushed into the small tube on the side of the tray which snuffs it out. Fire risk is lessened and no odor of a lingering smoke remains to disturb the anti smokers



A snuffer for the cigarette tray

Subsidies to Purchasers of Farm Tractors in France

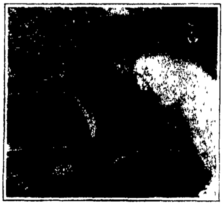
AGRICULTURISTS in the La Rochelle consular district, which has numerous large farm areas adapted to mechanical culture, are interested in the recent Government announcement of subsidies to be given to agricultural societies or groups of cultivators purchasing farm tractors

The law of 1915 which granted subsidies of 33 1/3 per cent, and that of 1917, giving 50 per cent of the cost to buyers of tractors, were war measures taken to assist in assuring production of food supplies, and funds for this purpose placed at the disposal of the Minister of Agriculture are no longer available A decision has now been reached continuing the assistance to the extent of 25 per cent of the cost for tractors built in France and 10 per cent for those imported from foreign countries Conditions of the grant are the employment of tractors under 25 horse-power for three years and those of over 50 horse-power for five years, and that tractors of from 25 to 50 horse-power shall be used on at least three different properties and over 50 horse-power by at least five to insure wide use

Representatives of several American concerns manufacturing farm tractors are now in France making a survey of conditions and securing connections for representation

An Oil Can That is Never in Its Own Way

MANY an autoist has had the trying experience, in attempting to put oil in his crankcase in the absence of a funnel, of getting a good part of the precious lubricant on the outside of his engine, on the ground, on his fingers perhaps—everywhere in the world, it must sometimes seem, except down the opening of the breather. One way to remedy this would be to induce the car manufacturers to put the breather in a somewhat more easily accessible spot—but this is a remedy which the average automobilist is hardly in a position to apply So one of the big oil refiners has come to his rescue with an "easy pour" can for oil The trick consists in the very simple expedient of an offset spout; instead of being centered over the can, so that no matter what side we attack the problem from the rim of the cylindrical portion of the container is in our way, this spout is off at one side, flush with the wall of the can itself. It is equally easy to get this spout into contact with the breather and to complete the operation of pouring without a mishap.



The easy pouring oil can in use

A New Portable Grinder

A LIGHT, economical bench or portable electric grinder which is particularly intended for use as a valve facer has been introduced by a California manufacturer. With an extra hub and wheel this grinder can be used for grinding small tools such as drills and chisels. The 1/12 horse-power motor is mounted upon a rigid base and power is supplied from any convenient plug or socket. In grinding the valve is moved back and forth across the face of the wheel, which keeps the wheel true, the valve being revolved during grinding. The arm is graduated from 30 to 60 degrees Valves may be easily changed in the carriage as they are held in V's with a spring and the V's can be moved anywhere along the horizontal shaft to make allowance for worn places on the valve stem

A familiar makeshift reduced to a production basis

A Wire Brace for the Crippled Chair

YES, we have all done this trick to make old chairs last longer, but now someone has patented the idea and made the wire supports in a way that is much easier to use This adjustable chair brace comes in pairs Each end has a loop, while at the opposite end is a smaller loop into which a screw is put and placed in the bottom of the chair With the end of a screw driver or a pair of pliers, all the slack can be taken up by twisting

Car Strike and Motor Buses

TWENTY-TWO rubber companies in Akron confronted with the problem of transporting 65,000 employes to and from work during the recent street car strike operated several hundred motor trucks on schedules that enabled them to move the large force of people without loss of time Motor trucks and buses owned by one of these companies hauled approximately 4,000 people during each of the shifts at 7 a. m., 3:30 p. m., and 12 o'clock midnight. In addition they handled the crowds from the general office and factory office at 4:30 p m. It was estimated that the buses of one firm hauled 20,000 people a day

One of the innovations made in bus design was a six-wheel motor vehicle Equipped with a special street car body it is probably the largest motor bus in America. With the pay-as-you-enter arrangement, upholstered seats and complete equipment, it seats 44 passengers Including standing room, it will accommodate approximately 90 passengers comfortably. The tandem rear axle arrangement made possible greater traction and easier riding and enabled the huge bus to carry enormous loads.

The latest portable grinder

Bakelite for Airplane Propellers

THE use of bakelite for airplane propellers has been undergoing severe tests by the Army Air Service. The laminated walnut propellers have proved very susceptible to wind and storms even in short flights of from eight to twelve hours' duration in spite of the fact that the propellers were further strengthened with doped fabric such as is used for airplane wings and that laminated walnut is the strongest known wood.

The results obtained with bakelite have been reported to be very satisfactory. Several designs of propellers have been used but the micarta has been the most serviceable. The propellers are made by coating sheets of duck with bakelite, then pressing five or six of the sheets tightly together to form a board that is sawed out in the shape of a propeller lamination just as wood laminations are cut The bakelite is then molded to an exact angle in a special mold under pressure of 850 degrees Fahrenheit. Advantages obtained are uniformity of texture, strength, absence of warping, elasticity, absence of metal hub, uniformity of propellers made from the same mold, proof against abrasion, proof against moisture, including oil, freedom from checking and splitting, adjustable pitch feature resulting partly from elasticity, ease and rapidity of manufacture once the molds are completed and ready for use.

Laminated walnut propeller after a trial against wind and storm

Doing Away with the Loafing Charge

(*Continued from page 24*)

the truck body and raise it to whatever story is desired.

The loading and unloading of bulky and yet not extremely heavy packages is greatly facilitated by using drop sides or removable sides. If the body is used for regular routine delivery work, it is apparent that the drop side will save time as it can be handled more easily than the completely removable side assembly. For example, a bale of cotton weighs approximately 500 pounds. Hoisting this over the side of a motor truck can be easily accomplished by a couple of reasonably strong men provided the lift is not too high.

Cranes of various kinds are also of considerable value on trucks handling heavy materials. For example, in a truck delivering materials in barrels, it is possible to make the work easy for the driver so that it will not be necessary to carry a helper. This is done by fitting a simple, hand-operated crane to one side of the truck body at the rear end, provided with a swinging arm, which has a winch so that it can swing to any central point on the truck body and after the barrel is gripped by the hooks, the arm may be swung around and the barrel swung clear of the truck platform.

The best loading mechanism, where it is practical to use it, is a portable wagon- or truck-loader which will eliminate a large amount of hand shoveling in handling materials such as coal, gravel, etc., that is usually stored in piles. For example, by the use of a portable wagon-loader, it is possible to unload gondola cars of the hopper or dump-bottom type very easily, inasmuch as the car is run along a section of track and the load dumped in a pile. The portable wagon-loader, which in its simplest form consists of an adjustable bucket-conveyor mechanism mounted on wheels, carries the coal to a chute at the top which transfers it into the truck body. In another form of scoop conveyor, the material is lifted from the car interior by a chain conveyor operated by any suitable crane rigging which lifts the coal into a large, hopper-bottom steel bin. This is supported on a trestle work of sufficient height so that a motor truck can be driven under it to be loaded.

Some forms have belts instead of metal bucket conveyors. In the belt form, two forms of cleats are provided depending upon the kind of material to be lifted. The usual speed of a conveyor belt is about 170 feet per minute. When the belt is fitted with low cleats it is suitable for carrying material such as bricks, coke, coal in large sizes, bags, boxes, paving blocks, tile and similar materials. When the belt is provided with high cleats it can be used for handling material such as fruits and vegetables, smaller sizes of coal, ashes, crushed stone and other substances of similar nature.

Perhaps the most common form of special body that has received general application and which is adapted for a wide range of industrial use is the rear-dumping body having hydraulic or mechanical hoisting mechanism. These dumping bodies are made in a wide variety of different patterns and differ in design according to the requirements of the people using them. Some of these bodies are centrally pivoted on the longitudinal axis and may be tilted so the load is discharged from one side. Others, which have been designed for use with trailers, are bottom dumped. Evidently the bottom discharge construction would not always be as practical on a motor truck chassis as it is on a trailer because of the parts of the truck mechanism that are carried on the frame underneath the body.

The usual form of dumping body is pivoted near the back end and lifts up so its load can be discharged through the tail gate at the rear. It is possible to make a body of this type with a hopper-like back so that it is not necessary to use a tail gate. Automatic dumping bodies are designs in which the material is carried in a box having a sloping bottom so that it will discharge without tilting the body. This method of construction is not always advisable because there is considerable loss in the available cubical contents of the body. Some forms of bodies that are used in the coal industry which provide automatic dumping features are so mounted that they may be elevated so that the load will be raised six or eight feet higher than the ground.

Hoisting mechanism is of two general forms: those in which the body is lifted by arms actuated through gearing which may be turned by a hand crank by man power or through a power take-off by the engine, and that type in which the work is done by hydraulic means. The mechanism employing reduction gearing is merely an improvement on the old type that was formerly hand operated and provided as equipment on horse-drawn vehicles.

The present hydraulic type of hoist would not be practical except on motor trucks; they cannot be operated very well by hand, for they require motor power to turn the pump fast enough to lift the ram in a reasonable length of time.

An important consideration in the designing of all dumping bodies, whether these are to be of the automatic type, or that form in which the wagon body is raised, is the angle of slide. This means the minimum angle with the horizontal at which material will move by its own weight. Naturally this angle is altered by the nature of the material and the type of body construction. Authorities state that an angle of inclination of forty five degrees will be ample for dumping any of the materials usually handled in dump bodies.

In certain classes of contracting work and around industrial plants, portable lifting cranes and derricks have been installed on standard motor truck chassis. Some of these derrick mechanisms have a capacity for lifting six or seven tons, the load being raised by block and tackle arrangement which is operated by a motor driven winch or windlass carried behind the driver's seat and operated from the truck engine.

The reason a separate engine is used on some of these derricks rather than employing the truck power plant is that the amount of power required for operating the derrick is considerably less than that delivered by the motor truck power plant.

Other trucks have been designed that use a traveling telpher which is provided instead of the usual form of derrick boom. These are suitable for lifting very heavy loads and are simpler in construction than the derrick is. Their use is limited, however, as they can only lift material from the truck body to the immediate rear of the truck or lift it from the ground back of the truck into the body. In order to permit mechanism of this kind to handle heavy goods, a pair of substantial screw jacks is carried by the rear of the chassis. These are dropped down to the ground and adjusted to support the rear end of the frame and relieve the truck springs and tires of the heavy load. When the jacks are down, a rigid platform is obtained.

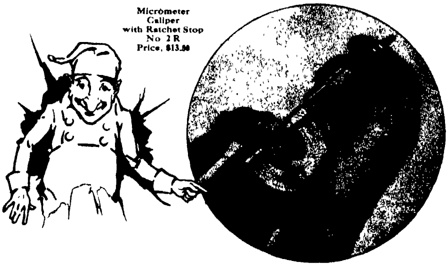
Aircraft for Pleasure

(*Continued from page 25*)

The Longhead motor weighs approximately 90 pounds, is water cooled, and has two horizontally opposed cylinders with a bore of 3⅝ inches and a stroke of 4½ inches. There are two independent magnetos; and two high pressure gear-type oil pumps. The radiator, as noted above, is mounted in a novel position, immediately under the fuselage—the most log-

(*Continued on page 37*)

GOODELL-PRATT
1500 GOOD TOOLS



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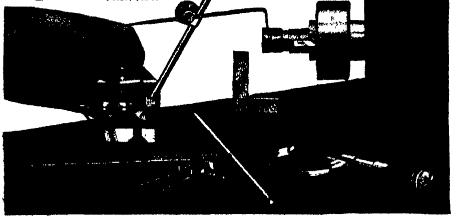


Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

BRAKE FOR AIRPLANES.—W. E KARNES, 58 Midland Ave Arlington N J The main object of the invention is to quickly reduce the speed of an airplane in order to avoid collision while in the air or to bring the machine to a stop after having traveled only a very short distance along the ground, the device for accomplishing this result is secured to the tail portion of the fuselage and is easily operated by the aviator and is at all times under his control

METAL CONSTRUCTION.—D. J. MOONEY, c/o The Steel Wing Co., Ltd, 48a Gillingham St, London, S W, 1, England This invention relates to airplane construction and means for joining the spars or longerons with ribs at an angle thereto, an object being to provide a construction and arrangement of saddle which insures a rigid connection of the parts and which maintains the continuity of the rib shape, and structural work to constitute the skeleton or support of the planes A further object is to provide a construction embodying maximum strength, but which is relatively light in weight

Pertaining to Apparel

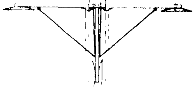
CORSET.—S J NEWMAN Box 1716, New Haven Conn The object of this invention is to provide a corset of the front lace type with a cut away front section in part of the garment for presenting a proper supporting structure while allowing an unusual amount of freedom adjacent and above the waist line A further object is to provide a corset with an elastic vest structure at the front where the upper part of the front is cut away.

COMBINATION OVERALLS.—M M. HORN, Eau Claire Natl Bank Bldg, Eau Claire, Wis This invention relates to a combination overalls The garment may be worn conveniently in four different ways, to wit As a regular overall with suspenders and bib, as a hip overall without bib, as a complete union suit or union overalls or as an overall with bib and jacket without suspenders the jacket and trousers are separate and means is provided to adjustably connect the same

CORSET.—S J NEWMAN 43 Oak St New Haven, Conn This invention relates specifically to a front lace corset with an arrangement of elastics so that there will be appreciable openings there between the same being associated with steel or whalebone pockets extending across the openings whereby the flesh cannot protrude through and whereby ventilation will be provided The arrangement presents a cool construction of corset for use in summer

Of Interest to Farmers

SCARECROW.—C A DAVIS, 526 S Flower St, Los Angeles Cal Among the objects of the invention is to provide a scarecrow with movable arms which can be operated from a distance A further object is to provide scarecrow embodying a support and a pair of movable arms operating cymbals to sound an alarm, and frighten away birds in fields, gardens and other places

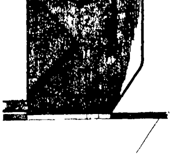


A TOP PLAN VIEW OF THE DEVICE

SEED PLANTING GAGE.—G A WARNECKE, 579 Fairview Ave, Brooklyn N Y The invention relates more particularly to a device for planting seeds in small quantities It is the prime object of the invention to provide a device by the use of which seeds may be properly placed with respect to each other and all planted at a single operation Seeds of various sizes may be planted and the spaces between the seeds varied at will

COMBINED CLAMP AND WHEEL GUARD FOR FARM WAGONS.—I P WELLS, Box 1, Gearing Neb The foremost object of the invention is to provide a device for keeping the front wheels of a farm wagon from wearing holes in the adjacent corners of the wagon box in making turns this device being in the nature of a metallic guard to be applied to the places where the wear usually comes, it at the same time including a clamp for holding the upper board of the wagon box side down.

GRAIN CLEANER.—C METTLER, SR., Menno, So Dak This invention relates to a device for cleaning, cooling and drying grains by air blasts. The object is to produce a device by which various grains may be cleaned, cooled, dried and otherwise improved, which is simple in construction, easy to make and carries no mechanical parts to get out of order, or require lubricating



A VERTICAL LONGITUDINAL SECTION OF THE CLEANER

HAYRACK.—W M DE WITT, 632 Rockford St, Elkhart, Ind The invention has for its object to provide a rack of the character specified, having fastened at the center thereof an auxiliary rake hinged to the main rake to tip forwardly to carry the rear part of the load to the front part of the main rack

IRRIGATION DAM.—H J CULLY, 923 10th St, N W, Washington, D C The invention has for its object to provide a dam of the character specified wherein the dam is arranged to be displaced at the end of a predetermined time by drip controlled machanism to permit the water to flow freely after a predetermined time

Of General Interest

CURING HOUSE FOR SWEET POTATOES.—E J ILES and O L HASTING, Alexander, La This invention relates generally to storing and curing devices for vegetables, and more particularly to a sweet potatoe curing house by means of which a desired degree of heat may be steadily maintained and thoroughly circulated, and a further object is the provision of a construction which is readily adaptable to different localities under different prevailing conditions

BOTTLE WARMER AND STERILIZER.—W E LAWSON and W. R SMITH, address Lawson Smith Mfg Co, Rahway, N J The invention relates to means for warming nursing bottles and consists of a container presenting a body and a broadened bottom portion, said bottom portion being adapted to hold a quantity of water and the container being adapted to receive the bottle to be warmed by steam generated by the heating of the water An object is to provide for supporting the bottle without contact with the bottom of the warmer thereby avoiding danger of cracking the bottle

DOLLS EYE.—O E DENIVELLE, c/o Lewis Amberg & Son 375 Broadway, New York, N Y This invention relates to dolls' eyes of the sleeping type and provided with eyelashes; its object is to provide a doll's eye arranged with eyelashes appearing exceedingly natural when the eyes are in open or in sleeping position Another object is to permit of securely holding the eyelashes in place and to allow of cheaply manufacturing such dolls' eyes

HAIR WAVER.—M MULLER, c/o Wm Kaufman 1482 Broadway, New York, N Y The object of the invention is to provide a device for waving natural hair on the head, whereby hair is permanently waved in a sidewise direction to cause the hair to be flat on the head of the wearer in perfect Marcel wave fashion Another object is to prevent the hair from becoming kinky or curly, and to prevent the hair from becoming overheated and injured during the process of waving.

CROW'S NEST FOR SHIPS.—A E DE SAYE, Grand Hotel, Mexico City, Mexico This invention has for its object to provide a crow's nest which is enclosed to afford protection for the lookout and which is supported by a universal joint on a boom which extends from a mast on a ship The crow's nest is provided with periscopes, telegraph and other means for communicating with the bridge and gun crews, and may also be provided with an electric heater for winter and fans for summer

FLOUR SIFTER.—C O NEPSTAD, Watford City, N D An object of the invention is to provide means for agitating the flour to cause the same to move through a screen and which is so constructed that the flour can be moved backwardly and forwardly through the screen until it is sifted to suit conditions. A further object is to provide a device which is capable of a wide variety of use

BELT BUCKLE.—W G AHRENDT, 105 Rose Terrace, Newark, N J The invention relates more particularly to a type of belt buckle in which a gripping element is arranged to have sliding movement longitudinally of the buckle for effecting a gripping action on the belt A more specific object being to provide a buckle of simple form, possessing strength and presenting an attractive appearance

ENVELOP.—J S CRATE c/o Humble Oil & Refining Co, Houston, Texas Among the objects of this invention is to provide an envelop more particularly designed for inter-office use, having means for indicating the destination of the envelop to any of a series of persons or locations A further object is to provide an envelop having a series of spaces thereon with a separable indicator adapted to be located in any of said spaces to indicate the destination of the envelop

CLOTHES DRIER.—P D RIORDAN, 131 E 86th St, New York, N Y This invention has been granted two patents on clothes driers, appropriate for city or suburban houses The first invention has for its object to provide a drier of the outrigger type wherein the frame when in operation may be positioned to extend entirely beyond a window sash, and when not in use may be folded against the window frame without requiring that the operator leave the building, making it possible to dispense with the lines usually found in the yards of city dwellings. The object of the second invention is to provide a drier for use on lawns, verandas and similar places, this construction is such that it may be stored in a very small space when not in use, yet when in operative position will support a number of articles of clothing

TOBACCO BITER.—L E ASHENFELTER Supply Co, 32nd Infantry, Camp Kearney, Cal This invention relates to an improvement in tobacco biters, and has for its object to provide a device of the character specified for tobacco chewers' use adapted to be connected with the plug, for severing when desired a piece of tobacco of suitable size for a chew

ASH TRAY.—A E LIEBNER, c/o Chas Miller, 148 E 92nd St, New York, N Y Among the objects of the invention is to provide a construction wherein the tray is supported so as to be readily clamped in a number of different positions while allowing a free pivotal movement in a horizontal direction as occasion may demand Another object is to provide a tray in which a comparatively light form of bracket may be utilized, and an interlocking supporting arm for connecting the bowl to the bracket

Hardware and Tools

CUTTING TOOL.—L. G. MORRIS, 1015 Park Ave., New York, N Y The invention relates to cutting tools particularly adapted for removing the skin from the animal An object is to provide a device in which the maximum amount of power may be transmitted without undue heating under varying degrees of pressure with which the device is applied to the carcass from which the skin is to be removed The cutter is so supported that it may be readily and quickly moved during the cutting operation.

CIRCULAR SAW.—A. MCCURRIES, 315 E. 3rd St, Aberdeen, Wash. The general object of the invention is to provide a circular saw for log sawing, shingle sawing, etc, so constructed as to have increased stability against distorting strains and tendencies set up in the saw when in action, whereby the saw will maintain its plane and promote economy by producing a kerf of the minimum width. A further object is to provide a saw with a detachable rim portion, permitting renewal without the necessity of discarding the complete saw.

METER SUPPORT.—L. MCNUTT, c/o McNutt Meter Box Co., Brazil, Ind. This invention pertains more particularly to connecting means for mounting a meter for ascertaining the amount of flow of material through vertical pipes. The prime object is to provide a support by means of which the meter may be readily attached to or detached from the line in which it is used.

TRAP.—J. MANNING, SR., Marathon, Texas The object of the invention is to provide mechanism in connection with spring traps, which is controlled by the closing of the trap, for sweeping the jaws free from obstruction which might hinder the proper closing, and for spacing the jaws, when closed slightly so that the bones of the leg of an animal caught will not be crushed

COTTER PIN REMOVER.—B TWETO, 1242 Jackson St, Missoula, Mont Among the objects of the invention is to provide a device of the character stated which can be operated by one hand and which will exert a minimum of leverage to insure an easy withdrawal of the cotter, the provision of a device which is neat in appearance and strong and durable in use

SCREW-DRIVER.—F. A HOLT, 360 Highland Ave, Arlington, N J. The invention relates to means for connecting the tool with the handle An object is to provide a tool holding pin which also functions as a means for holding the tool receiving nipple against rotary movement in the handle, yet which will permit the ready removal of the tool notwithstanding the strain and stresses which may be put upon the same

WOOD SPLITTING MEANS.—O. STAUB, Nicolaus, Cal. This invention has for its object to provide a wood splitting tool consisting of a wedge having longitudinal ribs on opposite sides, the opposite ribs merging into each other beyond the front edge of the wedge constituting separate entering points in advance of the wedge body in the form of separate wedge-shaped members

GROMET.—S ROBINSON, 510 9th Ave, Astoria, L I, N Y The invention relates to packing devices and particularly to what is known as a gromet, the object being to provide a construction which will effectively prevent leaks around a bolt when the nut is properly tightened Another object is to provide a gromet with radially positioned flanges and two laterally positioned flanges for engaging the nut or washer and the article clamped by the bolt.

LOCK SWITCH.—F T. EAGLE, 2009 8th Ave, New York, N Y The object of the invention is to provide a lock switch more especially designed for use in the ignition system of an internal combustion engine used on an automobile or similar power driven vehicle and arranged to enable the driver of the vehicle to render the ignition system inoperative Another object is to permit of readily installing the lock without requiring practically any changes in the ignition system

COOKING UTENSIL.—F. EIDT, 88 West St, West New Brighton, N Y The invention relates to a utensil for use with a frying pan and more particularly to a utensil adapted to be employed with a frying pan when cooking eggs, for example, whereby the cooked article may be lifted from the frying pan and the grease permitted to drain in the lifting

Heating and Lighting

FLUID HEATER.—J. BRAUNSTEIN, 76 W. 114th St, New York, N. Y. This invention aims more particularly to provide a device which shall utilise heat which is normally wasted, for the purpose of heating water. A further object is the provision of a heater which may be interposed in the flue of a burner, stove, or other heating plant, which is adapted to absorb all of the heat possible from the products of combustion coming in contact with the same and to transmit such heat to the fluid.

Machines and Mechanical Devices

CLOTHES WASHING MACHINE.—R. ELCOCK, Johannesburg, Transvaal, South Africa.

(Continued on page 55)

Aircraft for Pleasure

(Continued from page 35)

ical place for it. Fuel consumption is one gallon, and oil one-half pint per hour. The landing gear is of the usual type with a factor of safety of over 10 to 1. There are only five wires on each side of the body—three flying, one landing and one drift, all being neatly faired to lessen head resistance. A special feature which will commend itself to all private owners is the patented wing-folding device reducing the housing space required to such an extent that any good garage is a suitable hangar

Another small machine intended primarily for pleasure purposes is the "Butterfly" monoplane, built by the L. W. F organization of College Point, N. Y. The body of this machine is monocoque, ending in the vertical knife-edge common to most European machines A somewhat novel feature for a monoplane is that there is no cabane or structure above the fuselage to hold the wings in place by means of wire when the machine is on the ground. The latter are kept rigid by two diagonally placed wooden braces on each side, placed parallel, and running from either end of the chassis struts to about the center of pressure of the planes There is also a small vertical strut in between to give additional strength Wire cables prevent side sway

In passenger machines there are several models on the market, but they are all naturally more expensive both in first cost and in upkeep than the single-seaters Very powerful, and consequently, heavy motors are not really necessary in a pleasure craft where speed is not a first desideratum as in warfare, or lifting capacity would be in a commercial machine If a properly designed body and camber of wing allows a small single-seater to be safely flown with a 25-horse-power engine, it follows that a two-seater requires but little more power, certainly less than double, if the passenger is properly seated as near the center of gravity as possible, a feature often overlooked Weight distribution is a more important factor than is generally recognized

In conclusion one may remark that there is no reason why the airplane should not become as universally popular in the near future as the automobile Standardized types built on a quantity output scale should cost no more than the average motor car

Fifty Motor Truck Opinions

(Continued from page 26)

Yet it is also true that there is opportunity for standardization, namely, in the chassis One manufacturer suggests that truck builders should come to a standard dimension from dash board to back of seat box and for the width of two or three men cabs, so that the body builders could make up cabs in quantities and bring down their costs, thus effecting a saving to motor truck builders which could be passed on to the buyer This would certainly be a step forward in production

Are motor truck bodies too high? Perhaps there is room for thought in that question, for a leading engineer states that in his belief motor truck bodies will have to be made narrower or wheel housings will have to be included in the bodies in order to allow the platform of the usual body to be nearer the ground

Saving a Few Pounds Here and There

Pound by pound the motor truck builders are shaving down their truck weights in order to secure more economical operation, consistent with long wearing qualities and efficient service. As an instance, one builder has just put into production a tubular type propeller shaft which reduces the total weight of his truck just 32 pounds. In his quest for lighter weight this same manufacturer, some time ago, eliminated torque and radius rods as he found that the rear springs could be made to do their work better and at the same time eliminate between 400 and 700 pounds of weight.

Another builder has reduced the unsprung weight of his car 200 pounds by using pressed steel axle housings instead of malleable iron or cast steel On the one hand designers are simplifying and eliminating parts here and there to reduce weight, while on the other the engineers are turning to lighter alloys and metals Aluminum, we find, is being used in moderation It is employed by some for crank cases and underpans in order to reduce motor weight Regarding structural parts, drop forgings and pressed steel parts are gradually replacing heavier castings Heavy alloy steel is used in parts having to resist greater strains, but more from a standpoint of increased strength than a reduction of weight Of course, there is a limit to how light a motor truck can be made, consistent with efficiency A motor truck must have enough weight to get traction that's certain

The subject of weight introduces that of tires, which in the case of motor trucks looms up quite big in view of the keen rivalry between the solid and the pneumatic types The consensus of opinion is that the use of the pneumatic tire on trucks has opened large new fields which could not be approached with the solid-tired vehicle The pneumatic tire permits higher speed with heavy loads on good roads, and is also particularly adapted to soft roads since it does not cut into them as deeply as the solid type

Pneumatic or Solid Tires?

Automotive authorities do not look forward to any radical changes in the tire situation except that cushion tires are likely to become more common As for the choice between pneumatic and solid tires this is largely a question of circumstances Some authorities recommend solid tires for use on the larger motor trucks employed for city service and pneumatic tires on the smaller trucks and up to 2½ ton capacity For country use especially over roads that leave much to be desired in the way of smoothness, pneumatic tires are recommended

Obviously, this all means when boiled down to essentials, that the pneumatic tire has proved its worth in the past few years since its introduction Motor truck builders appear to be quite enthusiastic over the pneumatic tire, which offers greater resiliency and therefore permits of greater speed on the one hand, and better protection to the vital parts of the truck Furthermore, better traction can be obtained All these factors mean much in the way of lowered transportation costs Again pneumatic tires prolong the life of any truck and save on repairs However, as one authority points out, their maintenance cost—and they cost considerably more per mile—has caused some users to discard them It seems as though the solid tire and the pneumatic tire each have their proper field, and sooner or later they will settle down in those fields with little or no conflicting opinions regarding their most efficient applications

What of the Future?

The motor truck is no longer an experiment. Its field is pretty well defined It has solved the problem of short hauls and is the best known means or radii for connecting railroad diameters, as one authority puts it Up to 150 miles, the motor truck is held to be the most economical form of rapid transportation Its place in our transportation scheme is between the horse and the railroad; but it will be some time before it displaces entirely the former

As for novel applications, aside from the motor truck's regular use as a short-haul transport, there appears to be no limit. Today we find motor trucks equipped with flanged wheels doing duty on branch line railways and small rail-

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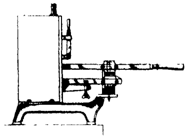
RECENTLY PATENTED INVENTIONS

(*Continued from page 36*)

A purpose of the invention is to provide a machine in which the liquid and clothes are agitated back and forth without substantial lifting, thereby making the machine light to work. Another object is to cause the liquid to flow relatively to, and through, the fabrics by mechanical means, and to subject the clothes to combined squeezing and rubbing and to a vibratory movement

BRAZING MACHINE.—R J PECK, 1916 Staples Ave, Key West, Fla. The invention relates to a brazing machine more particularly for use in brazing the ends of metal such as a band saw, together An object is to provide a machine which is compact and capable of being disassembled so as to occupy a minimum of space, and so constructed as to employ the conventional A C 110 V current, so that it may be operated wherever a lighting fixture is available



A SIDE VIEW PARTLY IN SECTION

AUTOMATIC GREASE CUP.—W E. RICH, 5 2nd Ave, New York, N Y This invention pertains more particularly to lubricators of the force feed follower type The primary object is to construct a device of this character in such a manner that the same may be carried by the moving parts of machinery without affecting the operation of the latter A further object is to provide a spring for operating the follower and also to provide in combination with the spring means for adjusting the tension thereof

PERMUTATION VALVE.—H. QUINN, 8014 Fort Hamilton Parkway, Brooklyn, N Y The invention relates to a permutation lock for controlling the flow of a fluid through a pipe in such manner as to render it practically impossible for any unauthorized person to cause or permit the flow of a liquid The lock is in the form of a rotatable valve plug having facilities for setting the same for opening of the valve at any desired points, assuming that it be desirable to change the combination from time to time

BALL BEARINGS.—A. GOLDEN, 10 S. Park Ave, Arverne, L I., N Y The object of the invention is to provide a ball bearing arranged to provide sufficient bearing surface to sustain the load without danger of injury to the raceway of the bearings and at the same time prevent binding of the balls in the raceway, and provide means for keeping the ball bearings lubricated.

GANGPLANK.—L W LANNING, Winona, Wash The invention has for its object to provide mechanism in connection with a gangplank such as are used for permitting passage of truck loads of freight, for registering the passage of the trucks in one direction, controlled by the passage of the truck in the said direction, and not controlled to register by the passage of the truck in the reverse direction

ELECTRICAL COIN DELIVERY MACHINE.—C MCDERMOTT, Freehold, N J An object of the invention is to provide a coin delivery machine for use in banks, merchandise establishments, and other places where silver coin is handled in making change transactions It is a purpose to provide a coin delivery machine consisting primarily of a coin delivery unit electrically controlled by a key board unit so that the cashier or operator of the machine may be distant from the coin delivery unit.

TACKLE BLOCK.—G HILGERS, Bothastraat 23 B Rotterdam, Netherlands This invention relates to tackle blocks in which at least one of the pulleys has rigidly fixed to it a ratchet wheel adapted to be engaged by a spring pressed pawl pivoted to the body of the block, the arrangement being such that the pulley is prevented from rotating in a lowering direction a cord being so connected to the pawl that by pulling the same the pawl can be raised to free the pulley

ROTARY STAMPING DEVICE.—J MERRY, 2842 N Maplewood Ave, Chicago, Ill. An object of the invention is to provide a stamping device for stamping letters, numerals and the like into metals. A further object is to provide a device with means for adjusting the die holding mechanism with respect to the articles to be stamped so that impressions of different characters can be neatly and quickly stamped, varying in size

PISTON RING.—H T. ANDREW, 395 9th Ave, W, Marion, Ohio This invention has for its object to provide a ring of the character specified, which is easily placed or removed, consisting of sections each of which is a split ring, but so held with respect to each other that pressure cannot pass the ring by way of the splits in the section.

SEPARATING APPARATUS.—E. L. MARSHALL, 328 London St, Portsmouth, Va. The invention relates particularly to a machine for separating peanuts. It is the purpose of the invention to provide an apparatus which is capable of completely and thoroughly separating the foreign substance from the peanuts, such separation being effected in the main by air blasts which are controlled to coöperate with the natural force of gravity.

PRESS FOR IMPRINTING AND DRYING MATRICES.—C. WINKLER, Berne, Switzerland. The object of this invention is to render the operation of said presses safer, easier and more effective than in existing presses so that the imprinting and drying of the matrices can be carried out in one operation Moreover precaution is taken to prevent the form from being injured during the process

ART OF LETTER-PRESS PRINTING.—C. WINKLER, Berne, Switzerland The invention relates to a means for keeping the press and inking apparatus in proper condition by combined heating and cooling The press comprising a former carrier adapted to be electrically heated, inking mechanism and means to circulate a cooling liquid through the ink distributing rolls against which the inking rollers bear.

AUTOMATIC SHUTTLE STOP FOR LOOMS. T F LOFTUS and F E. BRAZEAL, Box 271, Clifton Heights, Pa. The primary object of the invention is to prevent what is known as the "shuttle smash" or the breaking of the warp ends Another object is to prevent damage to the mechanism and injury to the weaver in the event that two shuttles are caused to collide as a result of the weaver making the mistake in putting shuttles in the shuttle race at both sides of the loom, the invention provides for the automatic stopping of the loom.

ROLL CLEANING DEVICE.—A. H. WHITE, 4902 2nd Ave, Pittsburgh Pa An object of this invention is to provide a roll which simultaneously cleans a pair of rolls of the type ordinarily employed in sheet metal rolling A further object is to provide a device with a mounting which permits the cleaner to be moved longitudinally of the rolls and which permits any desired pressure to be had during the cleaning operation

Medical Devices

DENTAL TOOL.—J L KELLY, Aeolian Bldg., 42nd St., New York, N. Y. The object of the invention is to provide a tooth polisher consisting of a handle, a conical metal socket, a polishing point composed of wood, and a shank on the point adapted to be forced into the socket, the shank having a plurality of contact points and between said contact points forming spaces between the shank and the socket

SPINAL TRACTION CHAIR.—E E HOLMES, c/o Alcazar Hotel, Room 1112, 47 W. 82nd St, New York, N. Y. This invention relates generally to a surgical chair, and more especially to a chair known as a spinal traction chair which is particuplarly adapted to selectively stretch or extend different portions of the spine to separate the vertebra One of the objects is to provide a chair of simple and rugged construction having means for obtaining adjustable movements between the devices and the seat of the chair

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ways, where the traffic does not warrant the operation of expensive steam trains. Motor trucks with suitable bodies are carrying tourists to the battle fronts of France. Many adventurous folk are traveling about the world in special cars mounted on motor truck chassis. In districts in which the sole business is the entertainment of summer guests and the period of such business does not extend over three months, de luxe bodies embodying Pullman car accommodations are now being mounted on trucks. Bodies similar to the present dining cars will follow shortly, connecting the isolated summer resorts with the main railroad routes.

X-Ray Tubes by the Hundreds

(*Continued from page 28*)

grinding. The rough anode head for the universal tube is formed from a sintered tungsten rod in a swaging machine, which is a nicely controlled high speed hammer used in this case to reduce, by successive operations, the diameter of the tungsten rod. The rod is heated to about 1,600 deg C in an atmosphere of hydrogen gas in an electric furnace, and is then rapidly passed through the swaging machine. In this operation the diameter of the rod is reduced 10 per cent. The rod is then reheated in the furnace and is ready for the next pair of swaging dies, which will again reduce its diameter by 10 per cent. When the rod is at the required diameter for the head of the anode, the end of the rod only is swaged down to form the taper and straight portion to which the molybdenum stem is attached. After rough grinding to approximate size and shape, the anode head and molybdenum stem are swaged together The assembly is completed by the addition of an iron collar and a thin metal tube and the finished anode is then polished and very carefully cleaned.

The tungsten wire used in making the filament for the cathode is produced in a similar manner, the rod being reduced in size in the swaging machine until it may be hot-drawn to the required size of wire through diamond dies.

The anodes for radiator type tubes are made by casting specially purified (boronized) copper around a carefully cleaned tungsten disk in a vacuum. Copper and tungsten do not alloy with one another, but under the conditions employed, the melted copper wets the tungsten and adheres firmly to it when it solidifies. This process assures good thermal conductivity between the tungsten and the copper. The finished anode heads are electrically welded to a rod of copper which is to extend out through the anode arm of the tube and support the radiator. The platinum or alloy sleeve by means of which the seal between anode and glass is made is silver-soldered to the copper rod.

For all cathode filaments, tungsten wire of 0.0085 inch diameter is used. The first operation in making a filament spiral is the winding of the wire on a conical mandrel of special tungsten steel. Before the spiral is removed from its mandrel, it is given an anneal in hydrogen in an electric furnace. Conical spirals thus prepared are next clamped in molybdenum forms and heated in an electric furnace to a temperature of 1,600 deg. C. in an atmosphere of hydrogen gas. This forming of spirals is carried out to give three different shapes of filament which are necessary to produce the various sizes of focal spots

The assembly of the cathode calls for very delicate manipulative work. Many of the parts are small, and in order to obtain the desired size and distribution of energy over the focal spot, the relative positions and shapes of these various parts must be nicely regulated. The tungsten terminals of the spirals in assembled cathodes are welded in place by arcing in hydrogen gas. One weld is made on the cathode cup and the other on the metal leading-in wire. This operation is carried out in an inverted glass bell jar through which is passing a stream of hydrogen.

All metal parts before being mounted in an X-ray tube are fired in a quartz tube vacuum furnace at 900 deg. C. for about an hour, and are allowed to cool down in a vacuum so as to prevent oxidization. The purpose of this firing is to render the parts perfectly clean and to remove partially the occluded gases and thus reduce the time required in the exhaust of the tube.

The bulbs and glass parts used in the tube are blown in molds at the glass factory and are therefore of uniform shape and quality. The operation of assembling these glass parts and the metal parts prepared is carried on by girls with the aid of glass-blowing machines of ingenious design. These machines are essentially lathes in which the two glass parts to be joined are clamped in separate chucks which are geared together so as to rotate at the same speed. Fires are provided for melting the glass, and compressed air, controlled by valves, for blowing.

The Coolidge X-ray tube requires a very high degree of vacuum for successful operation, approximately one ten-millionth of an atmosphere. In order to obtain this high vacuum, an elaborate exhaust system is necessary. As will be noted in the accompanying sketch, this consists of a series of three mechanical pumps, one condensation pump, and a trap surrounded by liquid air.

The X-ray tube to be exhausted is sealed directly to the glass tube coming from the liquid air trap. It is supported inside of a large oven, which is arranged with electric heaters for heating the tube during the first stage of the exhaust, and so constructed as to provide ample X-ray protection for the operators.

The first operation in the exhaust consists of heating the tube to about 400 deg. C. for three-quarters of an hour. This heating removes water-vapor, carbon dioxide and other gases from the glass and metal parts. After cooling, the tube is connected to an X-ray machine and operated as an X-ray tube. For the early stages of the exhaust, a machine is used which is so arranged that it operates automatically, passing just enough current through the tube to drive out the gas at the rate at which it can be removed by the exhaust system. The final stages are carried out on a regular interrupterless machine, and the operation has to be very carefully regulated by trained operators. As the vacuum improves, the potential applied to the tube is constantly raised. The operation is continued until all signs of gas, that is, appreciable green fluorescence in the bulb, have disappeared and the tube is backing up a 10-inch parallel spark gap and the anode is at an intense white heat. The whole operation requires about one and a half to two hours' time.

The foregoing description applies to the exhaust of the universal type of tube. The anode in the radiator type of tube cannot be heated as hot because of the low melting point of copper. The exhaust is carried out with the tubes connected to high tension transformers without mechanical rectifiers and requires a considerably longer time than the universal type. For many of these details the author is indebted to Messrs. R. C. Robinson and C. N. Moore of the Research Laboratory, General Electric Company.

The Trend of Motor Truck Design for 1921

(*Continued from page 31*)

shell. This type is considered better adapted for truck use than the cellular or honeycomb radiator because it will resist vibratory stresses better on account of its greater simplicity and strength due to the smaller number of parts used in its construction. Great improvements have been made in cellular radiator construction and also in providing spring supports for radiators of this type so that many

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makers continue to install the more efficient and lighter honeycomb coolers

Despite the agitation that has taken place in the past several years on account of the shortage of motor fuel and the recommendations made by oil producers and automotive engineers that more attention be paid to engine design in order to use kerosene, practically all truck engines are designed to use gasoline as fuel instead of the more plentiful oils of less volatility such as distillate and kerosene The double jet and compensating compound-nozzle types of carburetors are gaining ground rapidly, most designers favoring these forms above the old spring-controlled auxiliary-air valve type of a few years ago In order to take care of the lower grade fuel now generally sold, motor-truck engine-designers are taking the same precautions in regard to "hot spot" and heated manifolds to insure vaporization as are taken by designers of passenger car engines

A gain in electric starting and lighting systems is noted only on the "speed wagon" types which are modified from passenger car practice There have been a few cases where electric starting and lighting have been included as standard equipment on the heavier models but in most cases designers have not deemed it necessary to supply either electric lighting or the self-starting feature on the heavier or large capacity trucks, though provision is made on many designs so it can be fitted as optional equipment with an additional charge should operating conditions make it desirable for the truck to be so equipped.

Many truck designers, especially those who have developed new types of power plants for their latest models, are favoring the unit power plant idea, in which the clutch and change-speed gearing are attached to the motor to form a unit that is easily installed and that is much more compact than the old truck construction where the engine and clutch were one unit and the change-speed gear was another, usually placed at a central point in the frame When the unit-power-plant idea is employed, in order not to have an excessively long propeller shaft with the attendant dangers of "whipping' and vibration, it is now considered good practice to install a brake drum member at a central point of the frame This is carried by special bearings and serves as a tieup between a propeller shaft extending from the rear of the unit power-plant and one extending from the rear axle

The multiple-disk clutch using asbestos friction-material-faced disks is by far the most popular in modern truck practice Next in popularity, we have the three plate clutch, the cone clutch, which was formerly used in fairly large numbers is now found on relatively few truck models While the cone clutch is very simple and if properly designed, reasonably reliable, it is not a form that can be slipped very much without danger of burning the friction facing It is also apt to be harsh in engagement so the multiple-disk and three-plate types have been found to be the most practical and reliable for heavy-duty truck service.

The three-speed selective sliding gear-set is the most peculiar type in trucks up to 3,000 pounds capacity, there being very few light trucks equipped with four speed gears Even in the 4,000-pound class the three-speed gear still leads but the four-speed begins to receive increased application until in trucks of 5,000 pounds and over we find more four-speed gear-sets than three-speed Most truck makers continue to fit a power take-off only at extra cost

One of the points in connection with motor-truck design that has caused considerable controversy in the past is the best method of final drive At the present time this point seems to be fairly well settled as shaft drive is generally used, there being only twenty models, of the 682 reviewed, that were equipped with

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chain drive In spite of the fact that chain drive is the most efficient and will transmit a larger proportion of the engine power to the truck driving-wheels than any other, most truck designers favor some form of rear axle that permits a shaft drive system and enclosed gearing to be installed The majority of truck designers apparently favor worm drive as 446 out of 682 models are equipped with axles of this form

The protagonists of the double-reduction axle-form favor that type in which there is a primary reduction by means of bevel gearing and a secondary reduction by means of small spur-pinions at the end of the live-axle shaft which mesh with internal spur-gears driving each rear wheel There are in all 162 models provided with internal-gear-and double reduction-drive axles The larger number of internal-gear-drive axles are used in trucks rated at 4,000 pounds or less though models are found equipped with this drive even in the 10,000-pound class and the fact that there are no structural reasons for limiting its use is attested by the successful application of an internal-drive axle on at least one 7 ton model

The Hotchkiss drive system predominates in all trucks below and including the 6,000 pound classification For example, in the 5,000 pounds class the proportion is about two to one, there being twice as many Hotchkiss drive systems as all other types combined In the classifications between 3 and 5 tons capacity there are about as many trucks using the Hotchkiss drive as there are forms employing radius rods to relieve the springs of driving and brake torque reaction stresses The radius rod construction predominates in truck models of over 5 ton capacity In spite of the advances that have been made in the construction of so-called positive-drive differentials, that form of differential mechanism employing bevel gears and pinions is still the most popular The worm-type differential mechanism is a fairly close second in truck designer's esteem but the spur gear type is a very poor third choice

Practically all truck models are driven by the two rear wheels, of the number checked only twelve being found that followed the four wheel drive principle The road clearance on most trucks varies between eleven and twelve inches though in side chain-drive models it may be as high as fifteen inches Expanding brakes predominate because worm-drive axles are the most popular and most of these have expanding-shoe brakes housed in the wheel drums Contracting brakes are also very popular, especially for hand-lever actuation when they are mounted on the gear box of the unit power plant, as is common practice on many trucks under the 3,000-pound load-rating Designers of trucks having long wheel-base are favoring special contracting shoe brakes of large diameter which are mounted at a central point on the frame and which serve as a connecting member between shafts from the engine at the front end of the frame and the live axle at the rear end of the frame

The driver's position is now at the left side on practically all trucks, only 12 models being listed in which there is a right hand location for the driver's seat Most truck models are now provided with a cab which may be completely enclosed by means of storm curtains for protecting the driver and his helper during inclement weather This cab is usually built independent of the body and forms a part of the chassis It is so designed that any type of body may be used without interfering with or calling for the removal of the cab

The worm-and-nut steering gear seems to be the most popular and in the writer's opinion it is an ideal truck type on account of the ease of operation and the low reduction possible Owing to the slower speed of motor trucks large hand-wheels can be used, and two complete revolutions of the hand wheel are permissible to bring the wheels from one extreme angular position assumed in steering to the other

There is one point that is apparent to all who are following motor-truck development and that is the big increase in the popularity of large pneumatic tires, which are now installed on even very heavy trucks and which seem to be giving good service as regards long life and reliability These tires, which are of the cord type and provided with anti-skid treads of substantial proportions, are made in sizes up to 44 inches x 10 inches in reasonably large quantities and are found in some special cases of even greater diameter and in 12-inch widths As will be apparent, extremely large casings of these sizes are not handled very easily and in case of a puncture, which rarely occurs, it is somewhat of a job to change them on the road Special applying machinery has been developed for garage use but this is much too bulky for general service so it is customary practice to carry fully inflated tires mounted on demountable rims and provide metal wheels of special construction so the damaged casing may be removed with reasonable celerity and the inflated spare put on in its place The advantages of these large tires have been previously considered in these columns so that it is not necessary to review them at the present time

Something for Nothing

(Continued from page 32)

The Reclamation Act became a law of the land in June, 1902 It was a pet project of the late Theodore Roosevelt and was at that time strongly endorsed by the Republican party then in power. Since that time changing political complexions have not interfered with the act and under the Democratic administration reclamation was continued

During the war, reclamation like many other domestic problems was more or less relegated to the background But there is no reason which will bear examination why it should continue there The platform promises are specific, if vague in their terms Yet the American people know from sad experience that platform planks are all too easily splintered when occupied by their makers It is for us all to see that these promises are not forgotten when a new administration comes into being, and that the work be not starved for lack of an addition to the fund, which will enable work at present unfinished to be expedited and work which should long ago have been begun to come into being

We have grown so accustomed to thinking in terms of billions that the work which can be done with a hundred million dollars bulks small in our minds Yet the concrete result of the reclamation projects are enormous There are, for instance, more than 11,000 miles of canal in use, more than 1,600 miles of ditches and drains, 95 tunnels with an aggregate length of 144,847 feet, more than 13 million cubic yards in storage and division dams, half a million feet of dykes and levees, 7,293 bridges, 9,400 culverts, something less than three million feet of pipe, almost 700,000 feet of flumes, 1,450 buildings constructed and used by the service, 499 wells, almost a thousand miles of roads, eighty-three miles of railroads, 3,145 miles of telephone line, 650 miles of electric power transmission on line, and water steam developed to 60,375 horsepower. In the mere physical plant alone, then, it is evident that we haven't spent a hundred and twenty-three millions of dollars without getting something for it, and that our investment is safeguarded by actual property created, quite apart from the value given to the land irrigated by the operation of that created property

So far, twenty-seven projects have been approved for construction and nineteen have been wholly or partially completed But note that no new project can be undertaken unless the money to pay for it is in hand or in sight. *Before reclamation can be extended, payment for existing projects built must be made by those who are benefiting under them*

When reclamation was new and untried, as large a fund as has been spent seemed more than ample. But reclamation is no longer an experiment. It makes crops grow in profusion where formerly man could not live. One has only to look at the pictures here shown to see by more convincing exhibits than mere figures the magic wrought in the desert by water. Reclamation brings good homes to the homeless It provides paying work for the workless It makes towns and cities grow where none were before It conveys income into the treasury by producing taxable property where before was but a waste desert It makes crops grow where no crops ever grew, thus adding to the total food available for the country—and the more food there is the less expensive it is It brings into existence, as a pure by-product, power which before did not exist, note that the water used for power purposes is every drop available for irrigation, since what is taken from it in the development of power is energy not moisture Reclamation beckons the farmer from the unproductive farm to a productive one It calls to the city-bound boy to come back to the land where he can be certain of crops because certain of his water

Is not this, then, a matter which calls not for a careless "let it alone" policy of government, but for an expanding support which will keep the work up to present day demands? Why wait five, ten, fifteen years to finish existing projects, or commence new ones, merely to comply with the law as it is today? Why not change the law and add to the fund? For what have we developed engineering principles in dam building, surveying, irrigation such as the world never knew before? To what end do our engineers, our scientists and our mathematicians lead the world in all that pertains to making great lakes of water where water never was, in all that has to do with producing power where no power is, in all that concerns making a garden of a desert, if we are to hold them down to the purely political question of a revolving fund which must turn its slow revolution through the years before we develop that which nature gave us to have and to hold? Legislators and politicians who say they are sincerely interested in governmental efforts to reduce the high cost of living should have a hard time explaining to the people of the United States why they do not increase the reclamation fund

Leather Waste for Heels in Germany.

COMMERCIAL men who are interested in the laether trade are bringing out of Germany samples of a sole leather made from waste leather which is suitable for the manufacture of heels for shoes of all kinds The samples produced show a very firm, hard sole leather at first appearance suitable for any purpose for which sole leather is required. It is found upon close examination, however, that the leather is made up of pieces of waste leather which are likely to come apart when wet The leather is manufactured from waste and scrap leather from old shoes or any other kind of leather waste, and is cleaned and soaked in water and then rolled into sheets and subjected to high pressure The product has the appearance of a hard, dry, closely pressed sole leather, and for all purposes in shoemaking, when it can be protected to some extent from soaking, or can be fastened together as in the nailing of a heel, it gives promise of being useful and economical. The leather can be had at the present time at 17 German marks per kilo, which at present exchange figures out roughly at about 12½ cents gold per pound.

IN THIS ISSUE:

CANADA'S NIAGARA DEVELOPMENT
INSECT RAVAGES IN OUR FORESTS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in
INDUSTRY · SCIENCE · INVENTION · MECHANICS

28 FEB 1921

WIND STORMS MADE TO ORDER IN THE WORLD OF MAKE BELIEVE.—[See page 47]

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January 15, 1921

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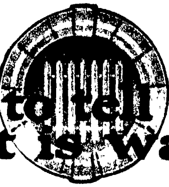
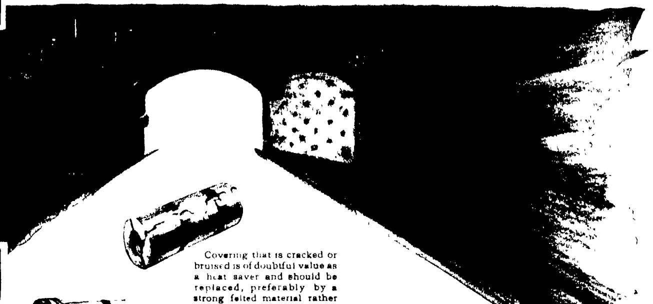


Six ways to tell how your heat is wasted

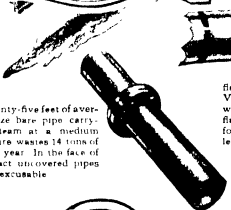
TO encourage fuel Saving we have thought it helpful to show some of the ways that heat is lost or wasted and how such losses can be located

The common causes for heat loss are not deeply hidden On the contrary, they are evident to anyone who will look for them.

If you find any one of the conditions below in your system, you can without a doubt be helped by Johns-Manville Insulation Service.



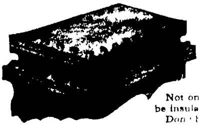
Covering that is cracked or bruised is of doubtful value as a heat saver and should be replaced, preferably by a strong felted material rather than the more easily damaged molded kind



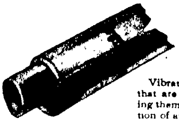
Twenty-five feet of average size bare pipe carrying steam at a medium pressure wastes 14 tons of coal a year In the face of this fact uncovered pipes are inexcusable

Often, pipes are covered but flanges and fittings left bare Very wasteful More fuel is wasted by leaving one pair of flanges bare than if a whole foot of the pipe itself were left uncovered.

Most coverings are too thin. You cover pipes to save heat. Why not save all that is possible by using proper thickness—instead of accepting the partial saving of thin inadequate materials.



Not only pipes but every hot surface must be insulated to secure maximum fuel savings. Don't be content with saving heat loss *from* pipes alone—find every hot surface and have it properly insulated.



Vibration wears away materials that are structurally weak causing them to sag, allowing circulation of air between covering and pipe, thus reducing their effective thickness and insulating value. Moral Be sure that the material you use has more than heat-saving value—that it has long life as well—preferably a *felted* rather than a *molded* material.

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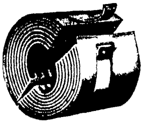

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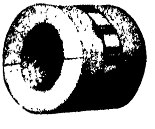

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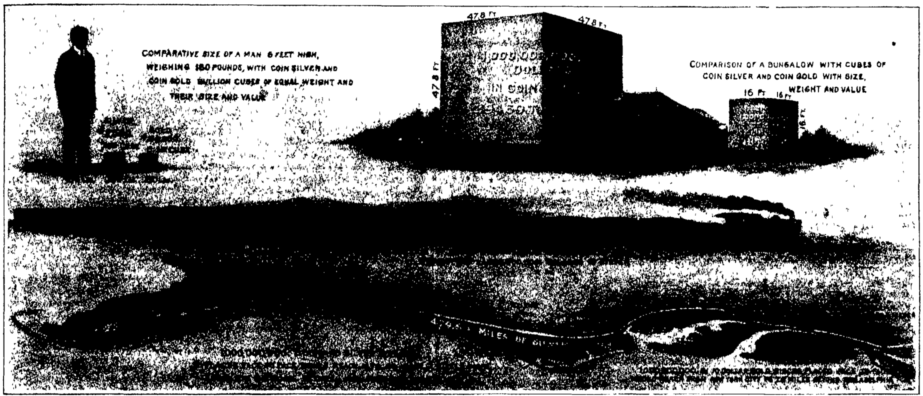
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A few attempts to demonstrate graphically the magnitude of a billion dollars

A Billion Dollars

NO statement of national expenditures or national indebtedness is complete, these days, that does not deal with billions in such a manner as to lead to the inference that a mere matter of hundred millions is too much of a bagatelle for any rational human being to concern himself with Yet it is to be doubted whether the average rational human being who is thus learning to talk in terms of billions has really acquired the ability to think in billions, at least to any extent enabling him clearly to visualize to himself just what a billion dollars means

Our artist has tried to look at this matter of a billion dollars from several viewpoints, and to draw a picture that shall give some inkling of what a vast quantity this number really represents As a starting point he asks us to consider the relative specific weights of the human organism, of coin gold, and of coin silver Coin gold and coin silver, it should be made clear, are not pure metallic elements, the former is alloyed with a small percentage of silver, the latter with no less than ten per cent of copper With this understanding, we are shown that a cube of coin silver weighing the 180 pounds which the statistician ordinarily attributes to the healthy adult male, would come considerably short of being knee-high to this healthy adult male, and would be valued at $2,500; while the same weight of gold would make a cube of considerably smaller size but of sixteen times the value

With these as units to work from, we find that a billion dollars in coin metal would make a wholly respectable figure alongside the average bungalow The gold, if we had it in actual coin rather than in a single cubical piece as illustrated, it might be possible to stow away in the house—the latter might not be 16 feet high but it would probably be more than 16 feet square. The silver, however, would be an entirely different proposition. To get a value one billion times that of the familiar cart-wheel of commerce we should have to pile up the white metal in a cube nearly fifty feet on a side—so that the bungalow, or even an altogether more elaborate mansion, would be completely thrown in the shade

The case would be far worse if it became necessary for us to transport this amount of silver bullion The train which we would require for this purpose would be made up, on the face of the figures, of 1,473 cars each carrying twenty tons of the metal Our artist tells us that this train would fill 14 miles of track—those who possess sufficient curiosity may perform a simple division to find out how long he estimates the single freight car to be Or if we felt that this disposition of our billion dollars did not make a sufficient show, we might string the coins out, face to face, along the Atlantic seaboard We should then find that we had enough of them to make a silver facing for the entire railroad route from New York to Key West while even if we used the far more valuable and far less bulky gold dollar, we could run the yellow streak well past Philadelphia

For the information of those who are sufficiently curious to desire to check up the artist, we may say that coin silver as defined by the current United States coinage regulations is valued at $13.92 per pound of 2.63 cubic inches, while its running mate in the circulation of the country is worth $223.20 per pound of 1.54 cubic inches

A New Airplane Wing

IT is claimed for the new Handley Page airplane wing that by its use landing speeds far slower than at present will be possible, or, on the other hand, greater loads can be carried or higher speeds obtained with the same horsepower It was shown that landing could be safely accomplished at speeds of 36 to 38 miles

According to a published description of the wing, "it has a much greater lift for every square foot of its surface compared with an ordinary wing The construction consists in having slots right through the planes, connecting the lower and the upper surfaces, and to the uninitiated it would appear that these slots, allowing the air to escape from the under to the upper surface of the wing, took away all the lift the reverse is exactly the case The slots in the wing virtually convert a single wing into a number of wings and increase the lifting power of the wing two or three times as much as would be possible in the ordinary construction"

Because also of the safety now attainable by flying at much slower speeds a great advance has been made, it is claimed, toward hovering, and "owing to their smaller size the wings can be built much more stoutly without increasing the weight, so that the all-metal wings become much more possible commercially Beyond this, with the high lifting capacity of these wings it is possible to fly more efficiently at full speed" A complete description of this new wing appears in the SCIENTIFIC AMERICAN MONTHLY for January, 1921, together with photographs and drawings

Bridge Building in China

A CABLEGRAM from Commercial Attache Julean Arnold dated at Peking, China, November 27, 1920, reports that the Ministry of Communications is calling for bids for a new bridge over the Yellow River (Hwang ho) on the Peking-Hankow Railway, to replace the present bridge which has been much criticized as not being of sufficient strength to carry properly the motive power that is being used The present bridge, which is by far the longest one on this line, is 9,875 feet in length, about 11 feet above high water, partly through trusses and partly deck girder construction, all supported on very elaborately placed screw piling One-half of the superstructure was fabricated in Belgium and the other half in France, and the floor system is all of the stringer type with the openings filled in with metal plates

It is understood that the specifications for the new bridge will call for a permissible loading of "Cooper E-50" The length of the new bridge will approximate 10,000 feet and will probably cost between $15,000,000 and $20,000,000 The Ministry of Communications reports that the specifications will be ready soon

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

"Ship Mindedness"

So far as we know, "ship-mindedness" is a new word, but excellent for its purpose. It was used recently by the chairman of the Shipping Board in referring to the loss of interest in the sea and things of the sea by the citizens of this country. "Unfortunately, in the years devoted to the development of our railroads and other overland means of communication, we lost our ship-mindedness and learned to lean heavily on ships other than our own in the over-seas carrying trade." The period of the development of our railroads in its more active form followed the Civil War, and the Civil War saw the close of the famous clipper-ship era, during which enthusiasm for the sea and ships was a distinguishing national characteristic.

The ship-mindedness of the clipper ship era was a fine spirit compounded of sportsmanship, romance, and high commercial adventure. Those were great days for ships and sailormen, and such was the speed of the one and the bold seamanship of the other that there were no ships afloat in the fifties that could compete in speed with the shapely craft that were fashioned on our northern coasts, and where could you find men that carried their canvas so daringly and with such apparent contempt for wind and weather as the Yankee skippers of New England?

The keenest contests for the America's Cup never excite a more absorbing interest and enthusiasm than that with which our forefathers followed the exploits and compared the speeds of the famous clipper ships of sixty years ago. Nor was any form of investment more popular than that of shares in some vessel built for the trade to California and the Orient. And not alone the daily papers of the seaboard cities, but the press of the far interior was proud to record that this or that flying beauty had reeled off so many miles in the twenty four hours or had cut the time from New York to San Francisco by so many days.

Yes, there was ship-mindedness in those days. And there was abundant cause for enthusiasm, as those who are familiar with the marvelous sailing records of that time will tell you. The most famous ships were not what would be called large today, running, in fact, from 1,000 to 2,000 tons register. But what marvels of speed they were! Models of the best of them are still to be seen in some of the old-established shipping offices, or preserved as priceless treasures in the homes of some of our retired ship masters. The underbody of the clipper was as different from the hull of the square-rigged or fore-and-aft merchantmen of today as the "Resolute" and the "Shamrock" are from an ancient North River trading sloop, for the fastest of these craft compare favorably in the fineness and sweetness of their line with the modern racing yacht. Some of the most successful were built according to the recently formulated waveline theory of those days, and they show a long, keen, hollow bow, great deadrise, a bilge round as a barrel, and a long, easy run.

The sailplan was laid out on a daring scale, and the spars and standing and running gear were proportioned to stand the hard driving for which the Yankee skippers were famous. Consider the sailplan of the "Great Republic," built in 1853, and the largest of the clipper ships. On a length of 335 feet, the height from deck to truck was 240 feet, and the length of the mainyard 120 feet. The fore and main rigging and backstays were 12½-inch, four-strand Russian hemp rope, and the dimensions throughout the ship were on a similar scale. As for the sustained speed of these ships, it was simply marvelous and is explained by their sweetly turned hulls, the enormous spread of canvas, and the big inducements, in the way of enhanced professional reputation and a cash bonus, for the captains to make rapid voyages.

These men were no fair weather sailors. It is a well authenticated fact that they sought rather than avoided the heavy gales, should these happen to be favorable to their course, and the results are recorded in their log books. There was the "Sovereign of the Seas," of 2,400 tons register, which in 1853, when running before strong westerly gales on a voyage from Honolulu to New York, sailed on four successive days 396 miles, 311 miles, 411 miles and 360 miles, which works out at an average speed of 15½ knots for four consecutive days. Consider the feat of the "Lightning," of 2,084 tons, which in 1854, on her maiden voyage from Boston to Liverpool, ran into a heavy southerly gale, during which the skipper, on March 11th makes the following entry. "Hove the log several times and found the ship going through the water at the rate of 18 to 18½ knots, lee rail under water, and rigging slack. Distance run in twenty-four hours 436 miles." This represents an average of 18¼ knots. It was twenty-five years before the steamship "Arizona," an Atlantic greyhound of her day, made 18 knots on her trial trip.

"Ship-mindedness." We shall not see again quite the sporting ship-mindedness of the middle years of the last century. The 25-knot speed of the "Lusitania" and the 54,000-ton displacement of the "Leviathan" represent a limit of speed and size which will not be surpassed probably for a decade to come. But there is a more serious ship-mindedness, which recognizes the present conditions as affording a great opportunity for the United States to take and maintain once more a leading position on the trade routes and in the ports of the world. In a peaceful sense, and with all friendly feeling toward other great maritime nations, we can say that in great part our future lies upon the sea.

Recent Milestones in American Aviation

In our recent review of progress in aviation during the past year, it was possible to deal with the subject only in a broad way without going much into details. The fact that commercial aviation, because of a lack of aerial laws, adequate landing fields and a definite government policy, did not get very far during the year must not shut our eyes to the fact that our American aircraft have advanced to a state of efficiency which is full of promise for the future, and the Manufacturers' Aircraft Association is fully justified in claiming that decreased production and the general contraction in industry are offset by the encouraging records of performance made by American machines.

In the matter of endurance, machines both for the Army and Navy have shown really remarkable efficiency. As evidence of this, take note of the trip of the "NC-4" from New York down the Atlantic and Gulf coasts and up the Mississippi River to Cairo, Illinois, and return, a round trip of 7,740 nautical miles, during which three of the four Packard-Liberty engines operated without trouble for 118 hours and the fourth for more than 82 hours. Even more remarkable as an evidence of efficiency and endurance was the trip of four Gallaudet two-seater machines, each powered with a single Liberty motor, from New York to Nome, Alaska, and return, a total distance of 9,000 miles, which was covered "without a motor missing fire or other accident serious enough to delay the party." Another long-distance trip remarkable for the speed achieved was that of a Boeing "D.H.-4-B" plane, which was flown from Camp Lewis, Washington, to San Diego, California, a distance of 1 160 miles, most of it over mountain ranges 7,000 feet high, at an average speed of 120 miles per hour.

The work being done by the Government Air Mail is too little understood by the American public. Thus, how many of us know that during last year this service, operating between New York and Washington and between New York, Cleveland, Chicago, Omaha, Salt Lake City and San Francisco, carried approximately one hundred million letters at ordinary postage rates. Again, as we go about our daily duties, do we realise that every day this service has some 35 air mail planes in the air and that they are flying a total in round trips, daily, of about 8,000 miles. As demonstrating the possibilities of time saving it is sufficient to instance the day on which a plane carried 16,000 letters from Chicago to New York in five hours and fifty-six minutes.

A severe test of efficiency is that of climbing with heavy load, and here we note that an Orenco machine carried four persons to a height of 17,150 feet and that a Dayton-Wright coupé carrid the same number of people to a height of 19,710 feet. The world's record for height in a single-seater was brought to America by a Packard-Lepere biplane, which reached an official altitude of 33,000 feet. Nor must we forget the feat of one of our army fliers, Donald Hudson, who in a Curtiss "Wasp," crossed the Andes at an altitude of 30,000 feet above sea level.

Nothing will popularize travel by air so quickly as to prove to the public that it is as safe as travel by land and sea. In this respect there has been a great advance, due to two notable achievements, designed to eliminate risks from fire and from forced landings. In the first case, Air Service officials, at Curtiss Field, saw a plane set afire in mid air and fly unharmed until the gasoline which had been poured over it had burned away. On another occasion U. S. Army officials conducted successful experiments with a reversible propeller, stopping a plane equipped with one of these within seventy-five feet of the point where the wheels first touched the ground.

A consideration of the above highly creditable record of achievements proves that the past year has been marked by a great technical advance in the art. The plane is ready for the public; all it asks is for proper laws, adequate landing fields, continued governmental encouragement, and sufficient financial support by the public for the establishment of new routes of travel and the improvement of the few that have been put in service.

Two Gigantic Waterpower Developments

The present high cost of fuel is not an unmitigated evil; for under the spur of necessity we are being driven to make use of other natural sources of heat and power than coal and oil, on a scale that otherwise might not have been attempted for decades to come. We have particularly in mind two power developments, one in England, and the other in the United States, each of which will be far greater in output than any waterpower plant at present in existence or contemplated. Of these, the British scheme is the more original, since it contemplates the use of the tidal power of the estuary of the Severn River. That the scheme is not visionary is proved by the fact that the investigations and plans have been drawn up under the British Ministry of Transport. Briefly stated, a dam 2½ miles long will be thrown across the mouth of the Severn and in this dam will be installed hydroelectric turbines of a total of one million horsepower. The total fall of tide is thirty feet, and to secure a continual supply of current, 500,000 horsepower will be delivered direct to the line and the other 500,000 horsepower will be utilized in pumping water to a high level reservoir, which will supply hydroelectric turbines during the five hours in which the stage of the tide will prevent operation of the turbine plant in the main dam.

The American scheme contemplates the building of a dam 500 feet in height, which will impound 93 per cent of the flow of the Colorado River in a storage basin over 200 miles in length, impounding more than forty million acre-feet of water. The total hydroelectric development as thus provided for will be over four million horsepower. It is contemplated to distribute this power over country covered by a radius of 500 miles, and embracing eight of the Western States. The gross hydraulic head of 3,560 feet will be developed at four separate power stations, located along the course of the river. The scheme has been under investigation for several years, and the application recently presented to the Federal Power Commission has been accepted.

Naval and Merchant Marine

The German Battleship "Ostfriesland."—A naval officer, writing of the ex-German battleship "Ostfriesland," speaks favorably of the watertight construction of each separate fire and engine room on this vessel, which is now at the Brooklyn Navy Yard. He thinks it is doubtful if a single torpedo or mine, or even two, would sink the ship. There are seventeen watertight subdivisions from forward aft, and within the engineering spaces these compartments are subdivided by two fore-and-aft bulkheads into three separate watertight compartments. There are no doors through the bulkheads below water line.

Torpedo Inefficiency.—It seems that in the earlier months of the war there were many cases in which British submarine attacks on warships failed because of the erratic running of torpedoes. One submarine officer of distinction has stated that in the first six months of the year, the British "missed bagging five large and seven small German war vessels in consequence of torpedoes running badly." It is thought that the fault was due to inefficient personnel who were not properly conversant with torpedo adjustments. Subsesuently, after more thorough training of torpedo specialists, the difficulty disappeared.

Daniels Now Favors Disarmament.—It is gratifying to note that Secretary Daniels has dropped the club of a super-navy, with which he fatuously imagined he could drive unwilling nations into the League of Nations, and has now come out in favor of an amicable discussion of a reduction of armaments by the naval powers that are most concerned. We have always regarded the call for rushing to completion the 1916 three-year program and the threat of a second three-year program as one of the most ill-timed and, in its effects, most disastrous policies ever set forth by a naval secretary. Mr Daniels cannot do better in the closing days of his tenure of office than seek to allay the post-war suspicion and unrest which his "big navy" talk has started.

Panama Canal Defenses.—Plans have been drawn up for rendering the Panama Canal impregnable. These are additional to the existing plans for the mainland defenses and include the placing of several of the longest-range rifles on Taboga Island, which is located about fifteen miles off the Pacific entrance. Presumably, these guns will be of the new 16-inch pattern. At the Atlantic end there will be a system of tracks designed for the heaviest railroad artillery mounts carrying guns of large calibers with a greater range than those installed on the most powerful dreadnaughts afloat. The terrain at the Atlantic entrance is well suited to this system of mobile artillery, which can be fully screened by the dense tropical growth characteristic of this locality.

Active Construction of Oil Tankers.—As an evidence of the activity of our private companies and yards in the construction of shipping under the provisions of Section 23 of the Merchant Marine Act of 1920, the United States Shipping Board has published the names of seven companies which have recently applied for the construction of the following ships, the capacity of which is given in deadweight tons. For the Atlantic Coast Company, two schooners of 2,400 tons, for the Boston Maritime Corporation, three schooners of from 1,700 to 2,400 tons, for the Luckenbach Steamship Company, a tanker of 8,800 tons, for the Standard Oil Company, five tankers ranging from 2,800 to 11,600 tons, for the Alaska Steamship Company, a 6,000-ton twin-screw cargo motor ship; for the Calvert Navigation Company, a 10,200-ton tanker; and for the Sinclair Navigation Company, two tankers of 6,000 tons deadweight.

The Jutland Controversy.—A disappointed British lay writer on naval topics, chagrined because his range-finding inventions were not accepted by the British Admiralty, started, after the battle of Jutland, a savage attack upon Admiral Jellicoe, who was in command. This was gleefully taken up by the enemy, and also, by certain elements among her own allies that were jealous of British sea power, and thus started the so-called Jutland controversy. The critics say Jellicoe should have dashed in and sunk the German fleet that afternoon and night; Jellicoe's defenders believe that since the fate of the allied cause hung upon the absolute control of the sea, Jellicoe was absolutely right in being content to drive the Germans back to Kiel and Wilhelmshaven and hold them there. His course was not spectacular, but it was sane strategy, as the event proved. To gain a victory with his fleet practically intact was wiser than to gain one with half his ships at the bottom of the sea, although the latter result would have been eminently pleasing, apparently, to most of his critics.

Science

Housing Conditions for Stock.—The Committee on Ventilation of Farm Buildings of the American Society of Agricultural Engineers is making a study of the proper housing conditions for live stock in various parts of the United States and Canada. An article relevant to this subject, entitled "Climatic Dairy Barns," is published by Messrs W B Clarkson and C S. Witnah in the newly founded journal *Agricultural Engineering*. The writers have divided the country into four well-defined zones, based on sustained low temperatures in the winter months, and have outlined the proper type of barn in its relation to such conditions for the several zones.

A Rat Adopted by a Cat.—In her recently published book "Wild Creatures of Garden and Hedgerow," Miss Frances Pitt states that she gave a baby rat, still blind, feeble and very naked, to a cat whose litter had been reduced to one kitten, then 10 days old. To her surprise, the cat accepted this unusual foster child. "The rat," says Miss Pitt, "was cleaned, fed, fondled, tended and treated just like the kitten, along with which it was reared. Even after another family came to occupy the cat's attention, she remained on friendly terms with the rat and often paid him a visit. The cat in question had been a good ratter, but after the adoption ratting was done with!"

The Seismological Service of Hungary has resumed its work, which was partially interrupted by the war, and has published in one volume a report on the seismograph records made at Budapest during the years 1913-1919. The director, Dr R de Kovesligethy, states that a large amount of apparatus had been ordered from Russia in 1913, and that when the war broke out he himself was in Russia, in his capacity of secretary of the International Seismological Association, making arrangements with the late Prince Galitzine, president of the Association, for the fifth conference. When, at the end of August, 1914, he succeeded in returning to Budapest, he found the seismological observatory deserted, the whole staff having been called to the colors. One of the assistants, A Hille, is still a prisoner of war in Siberia.

The Radio Compass.—The U. S Lighthouse Service, with the aid of the Bureau of Standards, has been carrying on experiments in radio direction finding as a means of navigation in thick weather. A radio direction finder was recently installed on the tender "Tulip," and automatic wireless signaling apparatus was placed at the Sea Girt light station and on the Ambrose Channel and Fire Island light vessels. The direction finder is so arranged that the directions may be read directly on a standard magnetic compass. The automatic wireless transmitting sets are of simple design, requiring no expert knowledge in their operation and no mechanical or electrical adjustments after the installation has been completed. The use of the direction finder is also quite simple, requiring no previous knowledge of wireless telegraphy. During the preliminary tests the master of the tender, after a few minutes' instruction, was able to operate the compass without difficulty, and in a run of about 43 miles, during which he navigated his vessel entirely by the radio compass, he brought the tender within 300 feet of Fire Island light vessel, for which he was heading, with only three readings of the compass, the last being taken at a distance of about 15 miles.

Systematic Photography of the Aurora.—The work of Prof Carl Stormer, in Norway, in making simultaneous photographs of the aurora at two or more stations in order to determine its exact altitude and position in space has now developed to such an extent that, during the remarkable display of March 22-23, seven stations connected by telephone were in operation, viz., Bygdo (Stormer's home), Oscarsborg, Horten, Christiania, Kongsberg, Fredrikshald and Dombaas. The distances between stations range from 26 to 89 kilometers. During the years 1911-1920 the stations at Christiania and Bygdö have made more than 300 successful pairs of simultaneous pictures, besides about 200 single pictures. Many fine photographs—single, double and triple—were secured of the aurora above mentioned. Several single photographs were made of some wonderful blue rays, which formed a "corona" of dazzling brilliancy, and which were so intense that they were photographed, with an exposure of less than a second, after the dawn had so far advanced that first-magnitude stars were barely visible. Prof Störmer reports that preliminary measurements of his photogrammetric pictures indicate for the upper limit of the auroral rays in the recent display an altitude of the order of 500 kilometers (310 miles). No aurora had previously been photographed above about 300 kilometers.

Automobile

Solution for Tires.—It is stated that bicycle tires and inner tubes of automobile tires may be made quite safe from small punctures by using a liberal amount of the following mixture. Procure 1 pound of sheet glue and dissolve it in warm water—enough to dissolve the glue only. After the glue has been dissolved add 1 quart of molasses. Remove the valve and inject this mixture—about one cupful—into a bicycle tire and a correspondingly greater amount in auto tubes, depending on their size. Replace the valve and blow up the tire. This mixture semi-hardens into an elastic jelly. This treatment will stop all leaks in a tire.

Emergency Repair of Rim Cuts.—Rim cuts are often given up as hopeless by the motorist, but they can be repaired in an emergency in the following manner. Drill or punch a series of holes on each side of the break at intervals of ⅜ of an inch and far enough from the edge so that they will not pull out. Lace the holes with a cord made of six strands of braided fish line, rawhide belt lacing, or any braided cord about 3/32 of an inch in diameter. Soak this lacing in paraffin or wax to make it waterproof, then thread it through the first hole, wind it around the bead, through the second hole, and so on. Let six inches of the cord or lacing hang over on each end for tucking away. Finally place a blow-out patch over the lacing inside the shoe to protect the tube against injury.

Large Export Trade in Motor Vehicles.—That the motor vehicle manufacturers of the United States have been busily engaged in cultivating foreign markets, despite the unprecedented domestic demand for their product, is revealed in the fact that exports of passenger cars and motor trucks in the 1920 fiscal year were 158 per cent greater than the previous twelve months and nearly 75 per cent larger than in 1917, the best previous year. In the twelve months ended June 30th, last, the United States exported 115,519 passenger cars valued at $41,577,684, a total of 139,875 motor vehicles worth nearly $167,000,000. This compared with 54,212 vehicles of all classes valued at $79,086,190 shipped out of the country during the previous year and represents an increase of more than 59,000 vehicles over exports of 80,785 in 1917.

Wireless Telephone for Automobiles.—A compact wireless telephone set operated with current from the batteries and generator of an automobile and transmitting and receiving over an aerial wire stretched from the top of the windshield to the radiator cap, is the latest equipment provided for the modern motor car or truck. It is one of the new developments introduced at the Electrical Exposition recently held in Grand Central Palace, New York. This apparatus, exclusive of the batteries and aerial wire, is contained in a box a cubic foot in size and the weight complete is 60 pounds. The price of a double set, one carried on the automobile and the other set up at home or at the office, is $350, which is not sufficiently high to discourage anyone whose business interests were such that they had to keep in constant communication with their office or home. It is not expected that many business men will find it necessary to use an outfit of this nature, but it is comforting to know that such an outfit is available if needed. Its utility on motorboats and for military purposes is apparent.

Cleaning Automobile Mechanism by Spraying.—A novel method of cleaning automobiles is being installed in some of the garages. This new cleaning process, which is the product of a Chicago firm, is stated to reduce the cost of the work and also eliminates the objectionable features connected with the ordinary methods of cleaning. The apparatus used consists of a long nozzle, held by the operator, through which a mixture of air, oil and water is sprayed on the automobile frame, axles or engine at a uniform pressure of about 90 pounds per square inch. The nozzle discharges the mixture in the form of a spray, which is directed against the surface to be cleaned at an angle of about 45 degrees from a distance of 18 inches. One gallon of oil is used to about 300 gallons of water, the proper mixture being secured by regulating valves attached to a special oil tank. The mixture of oil and water is carried to the nozzle by a ¾-inch rubber hose, the stream being broken up at the nozzle by air supplied through a ½-inch nipple. The temperature of the water used is about 100° to 120° Fahr., and the oil is a light-colored gas oil or petroleum distillate having a paraffin base. The cleaning can be done inside the garage, but more conveniently outside. It is stated that by this method an automobile can be thoroughly cleaned and that no difficulty is experienced in using the process in severe winter weather, and it has been operated with entire success at zero temperature.

A panoramic view of the forebay on the ledge above the Queenston power house

Canada's Niagara Development

The Details of the Queenston-Chippawa Project Now Being Pushed Toward Completion

By J. F. Springer

THE difference in level between Lakes Erie and Ontario is 330 feet The Hydroelectric Commission of Ontario proposes to utilize 305 feet of this head in developing electric power The plant as at present conceived will have a capacity of 300,000 horsepower this energy being developed from a flow of 10,000 second-feet This seems to be a higher practical efficiency than has been realized by any of the other Niagara developments According to a contemporary, the old Niagara River power plants got from 12 to 15 horsepower per second-foot, the Ontario Power Company's development on the Canadian side is in the neighborhood of 17, and the Hydraulic Power Company's development on the United States' side, about 20 The enterprise now being put through by the Hydroelectric Commission, since it will get 80 horsepower per second foot, is 50 per cent in advance of the best of the others

The map shows that the two most eastern of the Great Lakes overlap each other in an east-west direction At the eastern end of the overlap, the Niagara River connects the two lakes Niagara Falls is situated at a point on the Niagara River somewhat to the north of the middle Naturally, the various diversions of water above the falls tend to reduce the volume passing over the ledge The total flow of the river is estimated at 220,000 second-feet There is an agreement between the United States and Canada, under the terms of which 56,000 second-feet are allotted for power developments Canada has the right to 36,000 and the United States to the 20,000 balance At the present moment, the Commission controls nearly 18,000, and the project now under construction will add 10,000. It may be seen that our Canadian friends are busy utilizing their share

The new development is associated with the names of two towns on the Canadian side On the south bank of the Niagara River just before it makes its great leap is the town of Chippawa Here the Welland River joins the Niagara, after flowing in a generally eastward direction Another name for this stream is the Chippawa River Four and one-half miles of this river are being canalized from the Niagara River to a point near where the Michigan Central crosses. A power canal is being constructed north and northeast for a distance of nine miles This brings us back again to the Niagara River, but below the falls This point of junction is at Queenston. Here the power-house is being located The whole enterprise may be termed the Queenston-Chippawa Development. In the island thus created, the (Canadian) city of Niagara Falls is situated In fact, the power canal passes close to or through its outskirts

A remarkable feature of the foregoing plans is the reversal of the Welland River for a distance of 4½ miles from its mouth And not only this, but the western part of the river will no longer send its waters to the Niagara River above the falls but through the power canal to a point below them. Through the 4½ miles of the river bed, the Niagara River will send water westward to join that of the old Welland River in the power canal

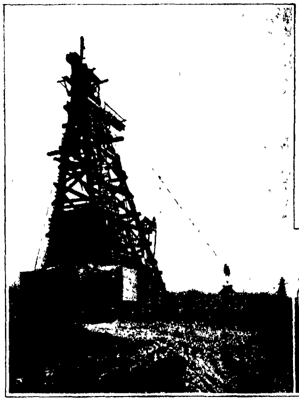
The velocities of flow in the old Welland River bed and in the power canal must naturally be adequate to carry the proper amount of water Where the cross-section is reduced, the velocity will need to be increased In the old river bed, where the cross-section is considerable and where less than the full complement of water is being carried, the average velocity is put at 2 feet per second. In the power canal, however, where the cross-section is never very large, the average velocity is about 6½ feet per second Naturally, the gradient is the principal factor in controlling the velocity, though friction does play a part

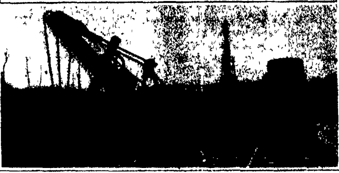
Control works will be located at the point where the old Welland River and the waters diverted from the Niagara River join to furnish the supply of power water for the power-house nine miles to the north. The difference between 330 and 305 feet is the loss in head from the theoretic ideal. Of the 25 feet, twelve are to be accounted for by the drop in level between the Niagara River and the control works, and eight by the drop in the power-canal Then two feet are allowed for the drop in the Niagara River between the power-house and Lake Ontario. The remaining three feet are allotted to friction—one-half foot to friction in the canal and 2½ feet to friction in the penstocks.

In general, the power-canal runs through a region where, after the removal of a heavy stratum of soil, the canal is bottomed in the rock. There is, however, a notable exception to this at a point opposite the Whirlpool. Here the rock is too far down to permit its utilization for the bed of the canal. It is conjectured that this sudden deepening of the bed-rock level marks a former course of the Niagara River gorge.

The form of the bed now being excavated for the power-canal varies a good deal. There are no less than six varieties of representative cross-sections. Near the beginning of the canal, the bottom is 70 feet wide and the banks are moderate slopes. The canal is here wholly in the earth. The banks are, however, protected with a heavy rip-rap facing. Farther north, the canal is deep in the rock but has earth on each side near the top The upper part is accordingly provided with a considerable width between the banks and moderate slopes down to lines set back somewhat from the margins of the rock. The rock portion has vertical sides Still farther north where the earthen portion is deeper, the rock part is narrowed At another location farther north, there is the earth section and the

(*Continued on page 55*)





Left Cable-way excavator at work on the the dry-land section of the job. The carriage is hauled back and forth on the cable suspended from the two towers, which move forward on their tracks as the work progresses *Center:* Small pilot shovel at work ahead of the giant steam shovel, claimed to be the largest in the world. *Right:* A closer sight of this huge shovel, which appears in the background of the middle view

Some of the tools, of novel design or unusual size, employed in cutting the Queenston-Chippawa power canal

1 Fifth Avenue open to traffic at 42nd St with the pedestrians lined up waiting their turn to cross 2 An instant after the change of signals the last vehicle to cross 42nd St, a big sight-seeing bus, is just getting clear, and the crosstown traffic is surging across The pedestrians get under full headway more quickly than the trolleys 3 The traffic tower that controls the situation

Traffic on Fifth Avenue, New York, under central direction from a single tower

Fifth Avenue's Traffic Tower

By Ralph Howard

SOME months ago a mysterious tower made its appearance in the middle of Fifth Avenue, just above 42nd Street, one of New York's busiest corners. It was at once apparent that the structure was to have some connection with the business of the traffic officer, but until the system of which the tower is the mainspring was ready to go into effect the precise nature of that connection was a carefully guarded secret.

The fact is, this system involved running the traffic on Fifth Avenue in an altogether novel manner. Heretofore on trunk streets of this sort there had been no particular effort to coördinate the work of the officers at successive corners. Of course, when the traffic is cut off at Umpty-first Street, if the officer at Umpty-second has ordinary human intelligence he will make some attempt to watch the tide of vehicles backing up toward him, and to open the cross street when it reaches him. But this isn't always easy—it involves a nice judgment on the part of "cop" and drivers which is not always possible to put into play, and a coöperation between them which is not always given. And in any event, when we have three miles of a main thoroughfare jammed solid with six lines of crawling vehicles, with much heavy traffic on the intersecting streets and a great deal of turning into and out of these streets from and to the main thoroughfare, the good that can be accomplished by isolated individual effort on the part of the officers at successive crossings isn't very large.

With each crossing operated independently of others, there is bound to be a good deal of unnecessary delay While the avenue is closed at, say, 49th Street, it is open at 48th, but to no effect because no cars can pass 49th, and when it is opened at 49th, this again is without effect because the officer at 48th selects this moment to pass the crosstown traffic which has been accumulating on his hands. Or again, the officer at 45th releases traffic on the avenue while 42nd is open to crosstown traffic; and immediately the back-wash from this blockade surges back as far as 45th, and there is complete deadlock here, with neither north-and-south nor crosstown traffic able to move. So the Police Department decided that in the interests of a maximum vehicular movement it was essential to introduce some system under which at all times the avenue should be either open to traffic throughout its length or closed in favor of the crosstown stream at every crossing.

The tower was put up to provide the necessary central control station for such a system. As a matter of fact, there are other towers, at 34th Street and other points, which relay the signals from the main tower at 42nd; but these are not really necessary, since the main tower is visible from all points between Washington Square and 59th Street. Facing north and south on this main tower are three huge lights. There is a green light to indicate that the avenue is open; a red light to show that it is closed in favor of the crosstown traffic; and a white or yellow light set between the other two, to give warning of a change.

The tower is not designed to do away with the officers at the individual crossings, but merely to superintend and coördinate their work. Each officer obeys the signals from the central tower implicitly The yellow warning which flashes for several seconds before the shift, say, from green to red, gives him time to get all north- and south-bound traffic cleared off his crossing; then when the red light finally beams out, he is all set to start the crosstown wave surging over without a second of lost time

The responsible authority over all this of course has

(*Continued on page 57*)

The Bureau of Standards developed this instrument for measuring the intensity of the sun's rays

Sunshine and Balloon Silk

By S. R. Winters

THE Government desired to know the contributing factors to the aging of balloon fabrics and the deteriorating influences to which gas balloons are subject The search for specific information on the subject gave birth to a new instrument designed by W. W. Coblentz of the National Bureau of Standards, described as a spectropyrheliometer, for measuring the component radiations of the sun Similarly, a problem was presented for offering a substitute for colored glass to exclude ultra-violet solar rays from the interior of buildings, these rays being injurious to structures

To study the sun seems far-fetched in its application to work-a-day problems However, when results are translated in the tangible fact that a buff or red paint absorbs the ultra violet and thus protects the contents of a building, the commonsense business man is willing to acknowledge that sunlight, science and a bucket of paint have something in common Colored window glass is expensive, you say Well, the Government scientist, who applied the unwieldy name "spectropyrheliometer" to a simple device, suggests that the windows be placed on the north side of a building, fixing them low, so that the direct sunlight concentrates on the floor This, and other expedients, so it is claimed, would save thousands of dollars on glazing alone Another effective method, determined by government tests, is that of varnishing common window glass with dilute asphaltum varnish in absorbing the ultra-violet rays

The new instrument for following the sun is mounted upon a polar axis, thus avoiding the absorption which takes place in a heliostat mirror. As illustrated in the photograph, this axis rests in a wooden frame Such an arrangement permits of the projection of the solar image directly upon the slit by means of a planocylindric quartz lens, 6 centimeters in diameter and 18 centimeters focal length A novel feature of the device for studying sun rays is the cylindrical lens which facilitates its operation without clockwork, the axis being parallel with the slit. The reflection from the sun, focused lengthwise on the slit, travels slowly, which fact offers opportunity for a series of readings without resetting Displacing the center line of the solar image 1 centimeter along the slit causes a variation of only 1 to 2 per cent in the measurement of the sun rays The image was accurately adjusted to within 1 millimeter lengthwise on the slit

Slightly turn the worm gear, and it is easy to follow the sun This gear is fastened to the polar axis by a screw which has a handle A slight twist of the screw releases the gear for speedy hand setting of the spectroscope in correct ascension. The declination setting is accomplished by a screw clamp, the fine adjustment of which is obtained by another screw, working in a nut attached in a pivot to the board supporting the spectroscope A counterweight is an accessory of the equipment, and when weights are used there is no vibration from the wind or from the manipulation of the worm gear. The apparatus was located on a lawn when making solar-radiation-intensity measurements, the weights on the cross boards insuring steadiness in operating the mechanism

The spectrum was produced by use of a quartz prism and two plano-convex quartz lenses, 6 centimeters in diameter and 18 centimeters focal length. These were mounted upon an aluminum plate attached to the board,

(*Continued on page 58*)

The Romance of Invention—XIX

An Inventor of Fighting Machines and His Work in Adding to the Efficiency of Navies

By C. H. Claudy

REAR ADMIRAL BRADLEY A. FISKE has stated emphatically that no man deserves the title of "*father of the new navy*." But no man can stand on the deck of a battleship, look about the modern mighty fighting machine and see more inventions, devices and scientific and mechanical adaptations that had their origin in the brain of the observer, than can he. If he be not "father" to the mechanics of a fighting ship, he may safely be denominated one of the principal weavers of the pattern which has made the United States floating mechanism of destruction the most highly developed in the world.

Admiral Fiske was an inventor from boyhood. Among his early recollections is an idea for distilling sea water, which he imagined might have been highly useful to Robinson Crusoe, in which the vapor of boiling water was caught in an inverted cone with its rim turned inward to form a circular cup, the outside being chilled by either air or water. Another was a pair of separable sleeve links, to avoid the annoyance of inserting the ordinary links, which were later brought out commercially and proved a great success—indeed, one buys them now. It was another's patent, but Admiral Fiske recalls his invention of the same idea years before it was exploited commercially.

With more patents to his credit than he could count for the SCIENTIFIC AMERICAN, and having seen some of his more basic ideas adopted all over the world, Admiral Fiske can surely lay claim to being one of the successful members of the tribe of those who create the new and useful from their powers of thought and imagination. Financially, Admiral Fiske protests that he doubts if he has more than "broken even" on the game, first, because many of his more important devices have been presented to the Navy in the service of which he devised them, and second, because he has spent so much of the proceeds of other inventions in developing still others.

"And yet," he says, "there have been times when an invention made me some money which was most welcome, as in the case of an automatic lead pencil, which brought me a check for a thousand dollars in royalties when I needed it most. The fact that the sales of that highly successful automatic lead pencil dropped off to nothing shortly thereafter, for the very good reason that when the pencil was dropped the lead in it invariably broke, has nothing to do with the need for that thousand dollars nor the welcome it received."

Admiral Fiske has so many naval ideas to his credit and has seen so much of his thought and originality incorporated in the navy with which he, literally, grew up, that it is difficult to select the most important for mention. But the two which perhaps are the greatest monuments to his ability are his system of adapting telescope sights to navy guns, and the invention of the torpedo plane.

Admiral Fiske himself refers to his invention of the application of the telescope sight to large and small navy guns as "the most important idea I had ever had." There seems to be no question whatever that it at one stroke revolutionized gun-fire and raised naval gunnery from the lowly rank of a, literally, hit or miss piece of guess work, to an exact science. It is strange to relate that this invention came into being through the use, by the inventor, of another invention of his own. The Fiske range finder, which was, at the time it was first used, the most successful device produced for measuring ranges up to three thousand yards, the maximum effective range in 1890 (?) was idle during a cessation of practice firing on the "Baltimore." Admiral Fiske (he was not Admiral then) was looking through one of the telescopes of the range finder and watching the cross hairs of the instrument slide up and down on some sailing vessels, as they and the "Baltimore" dipped and rolled in a quiet sea. Right then the idea came to him that if all the guns on one broadside were elevated at the same angle from the deck while a telescope on deck was so depressed that the vertical angle between it and that of the guns was equal to the elevation of the guns necessary for the range, a broadside could be fired with so great an accuracy that every shot would register on the target at once. Admiral Fiske's idea was to "lay" the guns parallel with the deck, or at the same angle above it, depress the telescope to the correct angle as shown on a dial, find the target on the cross hairs with the roll of the ship, and then fire all guns together by electricity, and make them all hit at once.

This idea was patented, and the single claim which it carried is given herewith, because it in a way underlies all the modern practices of naval gunnery.

"The method of pointing a gun located on a rolling, heeling or vibrating platform, which consists in adjusting a telescope, also located on said platform, and movable on a transverse axis approximately parallel to that of the gun at an angle to the axis of the bore of the gun equal to a certain predetermined angle of elevation necessary to cause the projectile fired from said gun to travel to a given target, and second, noting the moment when the line of sight of said adjusted telescope is caused by the movement of said supporting platform to intersect said target."

This will be recognized as the gun-director system, adopted by all great navies and usually attributed to Admiral Sir Percy Scott, who developed it practically. From it developed Fiske's later patent for applying an individual telescope sight to each individual gun. This was accomplished essentially by securing the telescope, not to the gun itself, where sights had always been secured before—in such position the telescope would have stuck itself through the eye of the gunner in recoiling; but rather to a part of the carriage which moved with the gun but did not recoil.

It would be impossible today even to think of a modern fighting ship without electricity, without telephones. Yet Admiral Fiske has not only seen the old rough-and-ready fighting ship transformed from a rough hull carrying crude guns with small range to a highly specialized fighting machine which is one large and complicated piece of scientific apparatus, he has himself been at the head and front of the army which introduced the modern servant electricity into the fighting machine. It was in connection with his range finders that the first telephone was ever put on any fighting ship (the U. S. S. "Baltimore").

The invention of the torpedo plane has not yet been recognized by the world at large to the extent which Admiral Fiske believes it will be recognized; but it has been virtually adopted by the British, Italian, Japanese and American navies, and its development is being strenuously prosecuted. The torpedo-plane system of fighting is that by which an airplane or sea-plane, equipped with an automobile submarine torpedo which may be detached at the right moment, attacks a fighting ship and launches the torpedo at such close range and with such easy aim that the ship is practically helpless before the attack.

Admiral Fiske believes that the day of the big-gun, armored ship, as the paramount fighting unit on the sea is nearly over. And he bases his belief on a simple argument, which critics have not yet been able to refute.

"In considering the relative merits of two fighters, whether they be men with fists, or men with pistols,

(*Continued on page 59*)

Rear Admiral Bradley A. Fiske and one of his torpedo planes, which he is confident will eventually make naval warfare quite different from what it has been

Current Issue of the Scientific American Monthly

THE paper read before the recent meeting of the American Association for the Advancement of Science, by Prof. Albert A. Michelson, announcing that by means of the interferometer, he had been able to measure the diameter of the star Betelgeuse in the constellation of Orion, has awakened public interest, anew, into the vast extent of the universe. Of peculiar interest in this connection is the leading article of the January issue of the SCIENTIFIC AMERICAN MONTHLY entitled "Limits of the Universe," by Dr. Svante Arrhenius, president of Nobel Institute of Physical Chemistry at Stockholm. He outlines the recent researches which have extended our concept of the star-filled heavens. The calculated distances of certain stars lie between 500,000 and 1,600,000 light-years, and the distance of certain nebulæ are estimated at the stupendous figure of twenty million light-years. As Dr. Arrhenius says, in conclusion, "We shall never be able to prove that the universe is infinite in space as well as in mass, but the millions of light-years with which our vision has been so suddenly enriched would indicate that no bounds are set to the spirit of research except those which are involved in the imperfection of our tools."

Charles W. Gilmore, Associated Curator of the United States National Museum, describes a new horned dinosaur from Canada, known to science as the *Styracosaurus albertensis*. This ancient animal had a skull 6 feet long which fairly bristled with horns. Dr. Gilmore compares the skull of the *Styracosaurus* with that of a horned toad, showing a very striking similarity, except that the latter is only an inch long. Were the horned toad enlarged seventy-two times to the size of its ancient cousin, its appearance would be even more bizarre than that of the dinosaur.

One of the most interesting of aquarian specimens is the little seahorse whose habits differ materially from those of other fish. The seahorse may be called the "kangaroo" of the sea, for it carries its young about in a kangaroo-like pouch. Strangely enough it is the male that carries the baby seahorses and shelters them until they are old enough to take care of themselves. When the father seahorse has arrived at the conclusion that the young must fare for themselves, he sends them out into the world by scraping his pouch against a rock or shell.

An interesting article entitled "The Cult of the Sound Body" describes the apparatus employed in modern physical laboratories to test physical development. The illustrations show the special apparatus devised by Dr. Boigey and Professor Demeny which have been installed at the Ecole Joinville. There are also several interesting pictures of apparatus for testing athletes employed in German schools of physical culture.

Is oxygen necessary for animal existence? The question is asked and answered by Dr. O. Krummacher. We used to believe that oxygen was indispensable to life until we found that certain minute organisms would flourish when entirely deprived of oxygen. Then we discovered that there are many bacteria to whom oxygen is actually fatal. It has been demonstrated that vital activity without oxygen is possible not only in one-celled organisms but also in animals with well developed systems of muscles and nerves. Just as it is possible to build an engine which would burn hydrogen and chlorine instead of oxygen and carbon, so it is possible for a living organism to produce chemical energy by the combustion of other gases, but the higher animals have learned to depend upon oxygen because it is found everywhere on our earth.

The efficient distribution of material in designing to withstand stresses in the structure is of prime economical importance especially in some of the modern mechanical developments such as airplanes where weight is a restricting factor. The quantitative determination of stress distribution and direction at all the various points in machine members is at best an intricate matter. A new method of determining stresses has been developed by George Weed Hall and Arthur L. Kimball, Jr., who are authors of an article on this subject. They determine stresses by transmitting polarized light through transparent models of the members to be investigated. The color effects produced in the model permit of measuring stresses which could not be calculated by mathematical methods.

A mine of useful information is contained in the article entitled "Metal Substitutes," which describes the various metals and alloys used in Germany to replace those made scarce by the war. The article is an astonishing revelation of the inexhaustible patience and marvelous skill of the German metallurgists. The translator of this article, C. Powell Karr, who is a member of the engineering staff of U. S. Bureau of Standards, has added appreciably to its value by his bracketed notes and criticisms.

Under the title "Weather Conditions and Flight," C. LeRoy Meisinger describes the climatological factors governing the selection of air routes and flying fields. Meteorology is the mainstay of aviation regardless of the confidence of the aviator in his motor and its ability to carry him safely over all obstacles. The record of our aerial service shows that the weather is responsible for the greatest number of accidents and forced landings. Many of these could be avoided by giving the weather its due consideration. Here is one of the places where the consulting meteorologist is certainly needed.

These are but a few of the leading articles in the January issue of the SCIENTIFIC AMERICAN MONTHLY in addition to which there are the usual departments of progress in general science, chemistry, electricity, mining and metallurgy and mechanical engineering.

A new department starts with the January issue devoted to the research work of the United States Bureau of Forestry. This is prepared by the Forest Products Laboratory at Madison, Wisconsin. The new department is to appear every second month.

Wind Storms Made to Order

THAT day is past when a thunder storm or tidal wave or cyclone in the films has to be announced by a title. Present-day audiences want realism, and that means the showing of the thunder storm or tidal wave or cyclone in picture form. A mere flip of the author's pen sets the scenery for his readers, and it is just as easy for him to call for the destruction of the Woolworth Building or the wrecking of the "Leviathan." But when it comes to filming—well, words cannot tell the story; nothing less than realistic action, no matter what may be the cost, is necessary.

Now wind storms are often required in photoplays. They do not always occur when wanted, and it costs time and money to wait for them. So—and this is typical of the ingenuity of the motion picture folk—a mechanical genius at one of the Fort Lee, N. J., studios got busy and developed a sure method of producing a wind storm wherever and whenever wanted. Taking a light automobile chassis and an eight-cylinder airplane motor fitted with a propeller, he developed the compact wind machine which is featured in our present cover illustration. When in operation this portable wind machine has to be chained to the ground lest it start off on its own account. The propeller blows the air past the engine and toward the scenery, as shown. The speed of the engine may be controlled so as to obtain anything from a gentle breeze to a full-fledged hurricane capable of bowling over the kind of scenery employed in motion picture work.

How Do Butterfly Wings Photograph Themselves?

SOME very curious biological experiments with respect to the self-recording power inherent in the delicate wing of a butterfly or a moth have been recently made by a German scientist named Gustaf Wolff, and are reported at length in the January issue of SCIENTIFIC AMERICAN MONTHLY.

When a butterfly's wing is laid for a considerable length of time upon a photographic plate, in a dark room, a clear image of the wing makes its appearance upon the plate when the latter is developed. In general the images are of the positive character, the dark parts of the wing coming out most strongly, while white portions make no impression at all upon the plate. Mr. Wolff states that it is the scales of the wing which exert the photographic influence, since when these are removed the wing fails to record itself upon the plate. The removed scales, however, are found to register on a plate.

Effect of Arsenic in Steel

IN view of the fact that the question has frequently arisen as to the effect of varying percentage of arsenic in steel, it was deemed expedient to make a few experiments at the Naval Gun Factory, Washington, in connection with the regular manufacturing operation on the effect of this element.

Two series of experiments were made, the first consisting of a comparison between a plain converter steel and steel from the same heat to which had been added 0.10 per cent arsenic. The second series was identical except that an addition of 0.50 per cent arsenic was made.

After making the final addition to a regular converter heat a 8¾-inch diameter by 32-inch long split ingot mold was top-poured from a bull ladle for this plain test. Then about 3 inches of steel was poured into a hot bull ladle of about 100-pound capacity, to cover bottom, the metallic arsenic, mixed with several times its weight of thermit and wrapped in paper, was thrown in ladle, the ladle was then filled with steel, mixed and top poured into a similar mold. This constituted the arsenic test ingot. Both series were handled in the same way.

The ingots were stripped the following morning, sent to forge shop, heated and forged longitudinally from bottom end to ¾-inch square, and cut into 6-inch lengths—a convenient size for test bars. They were not soaked or annealed before forging, but both series worked excellently while being forged. All of the 6-inch lengths were annealed at 1,400 degrees Fahrenheit and then heat-treated.

The results of these tests show practically no difference between the steel containing no arsenic and that to which arsenic has been added. While it is evident from these experiments that 0.3 per cent of arsenic is not injurious, as far as static testing can disclose, the fact must not be lost sight of that it is extremely hard to get rid of arsenic after it is once present in steel, and if the steel is used for scrap purposes after its usefulness has ceased, there is a constant automatic augmentation of the arsenic content which will in time get beyond the limits desired. It would also be interesting to note the effect of arsenic upon shock-resisting qualities of the steel which is of major importance where ordnance work is concerned.

A Newly Patented Cheap Building Material

A NEW patent has recently been taken out in Austria (No. 81157) by Dr. Rudolph Ditmar of Graz for an inexpensive building material, designed to relieve the shortage of dwellings which is felt there as well as here. The process is not strictly new, being based upon a system long employed by the Chinese and Japanese and other Asiatic peoples.

The inventor begins by placing two sheets of wire netting parallel to each other at a suitable distance and binding them together with wire. The receptacle thus formed is then filled with gravel sufficiently coarse not to pass through the mesh of the wire. The outer side of the netting is then covered with thick concrete which penetrates the meshes of the wire and unites with the gravel immediately in contact therewith, to form a layer in which the wire netting becomes embedded. After these outer slabs of concrete have hardened the gravel in the middle can be poured out and the space which it occupied filled by asphalt, tar, paraffin, or any other desired filler. Such a substitution is especially useful for the construction of the walls of ships or buoys or other articles where lightness as well as strength is demanded. The inventor claims several advantages for this kind of building material, including cheapness, the saving of more valuable material, and the readiness with which the hollow concrete slabs can be shipped to places difficult of access, such as mountain resorts. Furthermore, houses thus built can readily be "wrecked" without the use of explosives. They also provide an easy means of insulating the systems of pipes which supply the building and furnish excellent protection against extremes of cold and heat. He claims, too, that there is no sweating of the concrete.

Telegraph Wires as Weather Prophets

TO ears that are trained to distinguish the differences in pitch occasioned by variations in heat, humidity, wind pressure, etc., the telegraph wires which form a network over all civilized countries are said to constitute excellent weather prophets. A certain station master was recently quoted in the German magazine *Ueber Land und Meer* as making the following statements drawn from his long experience.

Predictions as to the state of the weather can be made 24 to 36 hours in advance by a proper appreciation of the pitch, strength, and quality of the tones produced by the wires. In particular rain, snow, and storms can be foretold with considerable certainty. In winter the tones are considerably higher than in the summer since the tension is increased by the cold. High shrill notes precede heavy but brief falls of rain or snow, while deep humming tones indicate rainfalls which are both brief and light. Buzzing tones indicate a change in the weather; indefinite soft, humming tones of medium strength indicate a longer continuance of damp weather.

It is naturally difficult to describe the tones with precision in mere words. They must be heard repeatedly in order that the mind may form consciously or subconsciously an idea of the weather condition to which they correspond. At any rate the station master's prediction of a heavy storm upon the day following the interview proved entirely true.

Insect Ravages in Our Forests

The Serious Character of This Plague and the Measures Taken for Protection

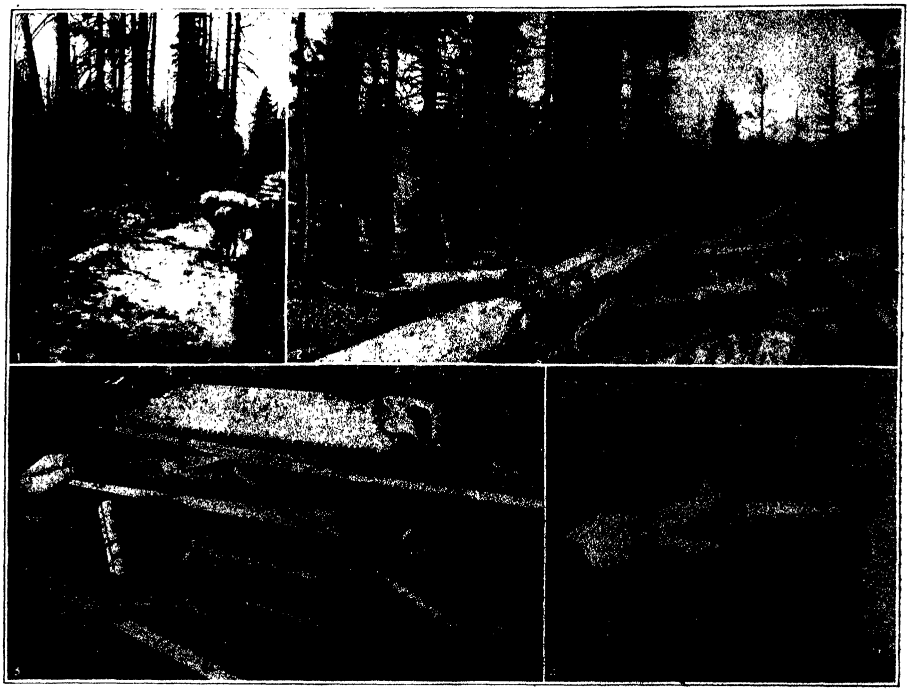
By S. R. Winters

THE beetle and other species of insects, stealthy workers that they are, may not commonly be reckoned with as contributing factors to the preponderance of evidence that the Nation's timber resources are being rapidly depleted The very insidiousness of the pests may be responsible for a tendency of the popular imagination to minimize the depredations of these tireless foes of the woods To be sure, they are not as spectacular as a forest conflagration or as ravaging as a cyclone but the destructiveness of insects may outweigh the toll taken by other inimical agencies

In fact, we have the 1920 official computation of the Forest Insect Investigations, United States Bureau of Entomology, which gives the figures $70,000,000 as the valuation of standing trees annually killed by insects An additional $30,000,000 is an estimate representing the losses sustained by forest products, such as stored hardwoods being converted into flour-like powder by powder post beetles In other words, insect injury is not restricted to "tall timbers" but their depredations involve attacks from the moment the seedling takes growth until the lumber reaches the ultimate consumer Compare the official estimate—$70,000,000 worth of growing trees yearly—with another Government calculation that forest fires take a toll of only $25,000,000, and you can realize the necessity for any drafted national forest policy taking cognizance of the natural enemies of trees It is estimated that half of the fir or balsam in eastern United States is either dead or dying because of neglect.

The bark beetles, or technically described as of the genus "Dendroctonus," are the chief offenders of a multitudinous array of insects that are tirelessly undermining tree growth As far back as 1836—85 years ago—an entomologist denominated the bark beetles as *killers of trees*, and the reputation of the pest is none the less ignominious in the year of our Lord 1920 The results of extensive investigations are unanimous in their verdict that the species of this genus of the beetle constitutes the arch enemy of the forest trees of North America Depredations by the eastern spruce beetle in the northeastern United States, widespread desolation of pine and spruce by the southern pine beetle in West Virginia and Virginia, the once almost complete annihilation of timber in a National Forest by the Black Hills beetle, and the undermining influence of the western pine beetle in Idaho, Oregon and California are examples subscribing to the fitness of the designation of the pests as "killers of trees."

Virile, upstanding trees are attacked by swarms of the adult beetles, their entrance into the bark being observed on the main trunk of the tree, where they dig their egg galleries for a distance of a foot or more through the inner, living bark. The vitality of the growth is weakened and subsequently the larvae which hatch from the eggs tunnel through and destroy the bark which may divorce one egg gallery from another The growth is thus completely girdled and death to the tree is inevitable. The toll exacted of our lumber resources in this fashion is staggering, the beetles in West Virginia, New England and the Black Hills National Forest alone mounting into the billions of feet of choicest pine and spruce. Depredations, perhaps less conspicuous, each year invade the forested sections of the Rocky Mountains, Cascade, Sierra, Coast regions and the Southern States. Dr A. D. Hopkins, in charge of Forest Insect Investigations, Bureau of Entomology, states that if the timber destroyed by insects during the past half a century were living today its stumpage value would be in excess of $1,500,000,000



1 Dead forest killed by mountain pine beetle 2. Beetle-infested trees cut down to control depredations. 3. Tools used for pruning. 4. Syringing for borers

Destruction wrought by insect pests in our forests, and means of combating them

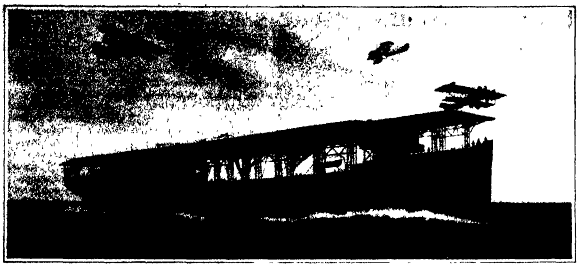
Recent years are replete with alarming outbreaks of insect depredations. The conspicuous example of the ravages of the pest in the Black Hills forest reserve is of historical significance, the toll being 1,000,000,000 feet of timber. The trap-tree method was employed in combating the attacks whereby trees were felled as a decoy in attracting the insects, after which the broods were annihilated by stripping off the bark or putting a torch to the entire tree. An outbreak of the eastern spruce beetle in northeastern Maine was subdued by diverting the logging operations from land to floating the lumber on the lakes and streams to distant mills. One logging enterprise, without additional expense,

(*Continued on page 60*)

The United States Aircraft Carrier "Langley"

THE "Jupiter," which is familiar to the public as one of our naval colliers, is now at the Navy Yard, Norfolk, undergoing alterations to refit her as a Government carrier. She has been renamed the "Langley" in honor of Professor Samuel Pierpont Langley, whose extended pioneer experiments on the problem of mechanical flight made his name widely known.

All of the coal-handling gear has been removed and in its place there is being built a flying deck, located about 56 feet above the waterline and extending from bow to stern, a length of about 525 feet. This deck has a width, amid ships, of about 65 feet, and it will be flush all over, so as to make an ideal platform for flying off and landing. Means will be provided on this deck for rigging an arresting device to facilitate landing. Catapults for projecting the planes to give them the necessary speed for flight will also be provided forward and aft. An elevator will be installed for hoisting the planes from below to the flying deck and around this elevator a palisade will be provided to form a wind break for protection to the planes while being assembled.



Length: over all 542 ft., *Displacement* 12,700 tons, *Speed* 15 knots, *Armament.* four 5-inch guns, *Aircraft Complement* 12 single-seated pursuits; 12 two-seater fire control; four torpedo planes, six seaplane torpedo planes

The "Langley" (formerly collier "Jupiter"); first aircraft carrier for the United States Navy

Two cranes with large outreach, one on each side of the vessel, will be provided to hoist aircraft out of the water and land them on the hangar deck, which is the deck next below the flying deck Beneath the flying deck, traveling cranes will be provided for hoisting planes from the hold and for transferring them fore and aft to the shop spaces and elevator Shop facilities for repairing the planes will include a machine shop, a wing repairing shop, molding spaces, a metal shop and various store rooms.

The hold spaces are being refitted for the stowage of aircraft and their accessories, including aircraft ammunition in the way of bombs and torpedoes, ship's ammunition, fuel oil and gasoline An elaborate system will be provided for distributing gasoline and lubricating oils to various stations on the hangar deck and flying deck. The characteristics of the "Langley," refitted as an aircraft carrier, are as follows

Length between perpendiculars	520 feet
Length overall	542 feet
Beam	65 feet
Speed about	15 knots
Displacement about	12,700 tons
Gasoline capacity	578 tons
Guns	4-5 inch

The smoke pipe has been rearranged so as not to obstruct the flying deck and to keep the smoke clear of this deck, in order not to interfere with making a landing This will be accomplished by providing a short smoke pipe on each side, clear of the flying deck, which will be interconnected so that the smoke can always be discharged on the lee side One of the smoke pipes will be arranged to hinge downward when considered necessary to discharge the smoke near the water, the other is arranged to discharge the smoke downward through a water spray

A radio outfit will be provided, carried on masts which are capable of being completely housed below the flying deck The "Langley" will carry an auxiliary radio outfit, so that the planes can be communicated with when the main radio outfit is housed

The "Jupiter" as thus reconstructed under her new name of "Langley" will carry twelve single-seater pursuit planes capable of maintaining a speed of 100 knots for three hours, twelve two-seater fire control planes capable of cruising for four hours at an elevation of 10,000 feet and having a full speed of 100 knots, four torpedo planes capable of flying at 100 knots for two hours, and six seaplanes built as torpedo planes capable of 80 knots' speed for four hours

Surgery and the Weather

THE well known Boston surgeon, Dr Huntington has been making certain observations as to the possible effect of meteorological phenomena in surgical operations He has come to the conclusion, after studying many cases in the two largest hospitals of the city, that a high degree of humidity, 80 per cent or more is the optimum condition for the performance of surgical operations, with a fall to about 60 per cent two or three days later, with a temperature of 18° C (64 5° F) Dr Huntington believes that these conditions could be artificially produced in the operating rooms

The United States Light Cruiser "Omaha"

AN important section of the three-year program which was drawn up before we entered the war was the provision for ten scout cruisers, a comparatively new type of vessel, at least as regards its steaming radius and high speed The most notable features of our new designs as compared with those of contemporary navies was their high speed of 35 knots, their large displacement of 7,100 tons, and their battery of eight 6-inch guns

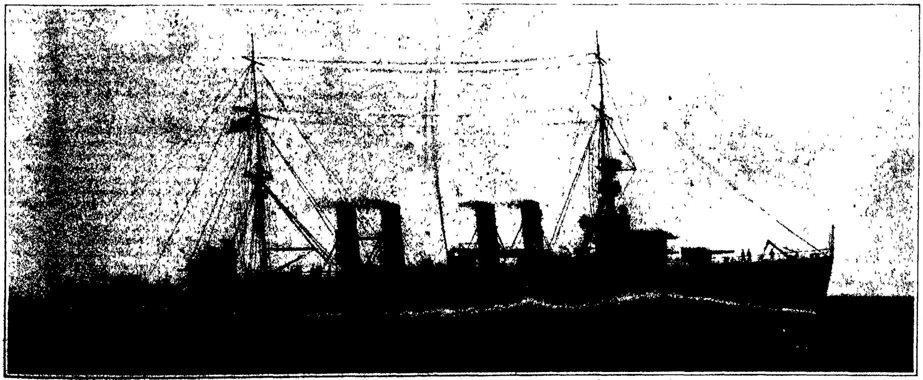
Since the designs were first drawn up, modifications have been made in the direction of increasing the strength of the hull and the power of the battery, and this has resulted in an increase of the displacement from 7,100 to 7,500 tons and a decrease in the speed to about 33 75 knots

As will be seen from the dimensions, these vessels, so far as the hull is concerned, are practically exaggerated destroyers, for with a beam of 55 feet and a mean draft of 13 feet 6 inches, they are 556 feet 6 inches in length overall, giving a ratio of beam to length of one to ten When the designs were first brought out, some fear was expressed as to whether their shallow depth, as affecting their girder strength, would not cause them to strain heavily when steaming head to sea, but from the official drawing from which our own wash drawing has been prepared, we gather that the freeboard for over one-third of the length amidships has been raised one deck If so, this will give greater strength and add both to their seagoing qualities and to their appearance There is a pronounced sheer with considerable lift toward the bow, which, even as it is, will be none too lofty if these boats are to be driven at nearly 34 knots in average weather The motive power as originally designed consisted of geared turbines operating on four shafts with a combined shaft horsepower of 90,000

The battery will be numerous and powerful, consisting of twelve of the new-pattern 53 caliber 6-inch guns It will be mounted as follows on the fo'castle deck will be a two gun turret, abaft of these on each side of the bridge will be two guns mounted in superposed sponsons, all of these six guns being forward of the bridge Aft will be a similar arrangement of six guns, namely, a two-gun turret well aft on the quarter deck, and forward of this, on each side, two guns in superposed turrets, these latter being slightly aft of the after bridge

An interesting novelty, at least in the United States

(Continued on page 60)



Length: 556½ ft.; *Beam:* 55 ft.; *Draft:* 13½ ft.; *Speed:* 33¾ knots; *Armament:* twelve 53-caliber 6-inch guns; two twin, 21-inch torpedo tubes

New scout cruiser "Omaha"—class of ten ships

Building a Rigid Airship

The Construction of a Dirigible, from the Frames to the Finished Ship

THE metal parts of an airship are manufactured in engineering shops equipped with special machinery, while the gasbags and outer covering are made in sheds of a suitable character with large open floors and with heating arrangements to maintain the air at a constant temperature. The methods of manufacture of the girders and other parts of the hull framework, the cars, rudder and elevator planes, and all other components of the airship, do not offer any special difficulties, and the processes adopted are those of ordinary engineering practice.

The metal invariably used for rigid airship construction is "duralumin," an alloy of aluminum characterized by combined strength and lightness. Its specific gravity is only 2.8, but it has a breaking resistance of 23 to 30 tons per square inch of section. Thus, although only one-third as heavy as mild steel, bulk for bulk, it is almost equally strong.

The bracing pieces for the girders are stamped out of strip, and pressed to shape in dies which corrugate them length-wise for the purpose of stiffness, except at the ends and in the middle where they cross one another. The main members are drawn out of strips to the required channel-section, and drilled for rivets in a special machine which automatically feeds them forward and drills them, the spacing between two adjacent holes being accurate to one-thousandth of an inch. As an enormous number of holes have to be made in these parts, the machine is a great saver of labor and time.

The bracing-pieces are riveted to the main members by pneumatic riveters. The rate at which the rivets can be closed is practically that at which the rivets can be placed in the holes.

Most of the girders are triangular in section, having three main members held together by as many sets of bracing pieces forming a lattice-work girder. To the uninitiated, the lightness of the girders is astonishing. A girder thirty feet long can be picked up with the greatest ease, for it weighs only some 15 pounds. Not less surprising is their strength—relatively to weight. A girder of the length and weight mentioned is able, if supported at the ends only, to carry a distributed load of 30 pounds per foot—900 pounds in all, or, alternatively, 450 pounds (the weight of three average men) concentrated at the center of the span. Such girders have the highest strength-to-weight ratio of any similar constructions yet produced.

In the engineering shops are assembled also the framework of the machinery and control cars. These are built up of members of a more substantial character, as the loads to be carried are greater and more concentrated. In principle, the arrangement of the parts is the same as in the hull, longitudinals held together at intervals by circumferential ring frames, the whole tapering aft in streamline form. Under the floor level the cars are covered in with duralumin sheeting; above, with fireproof fabric.

In the gasbag shed, girls stick the goldbeater's skins by means of rubber solution, on to sheets of cotton fabric, which are subsequently made up into the gasbags. The skins, of which over a quarter of a million are used in one rigid airship, are applied so as to overlap one another, trimmed off at the edges, and flattened down with the scissors. The process necessarily is a long one, since each skin covers but part of a square foot of fabric. Before lining, the fabric is made up into gores and ends of predetermined form and dimensions, so that when stuck to each other they make bags circular in section and having the necessary taper in one or both directions to fill accurately the compartments in the airship to which they respectively belong.

Each bag when finished is inflated with air and inspected from the inside, any faulty places being made good. The various fittings for the attachment of the gas valves, the filling necks, etc., are then fixed in position, and the gasbags are ready for the airship.

A bag after being passed as satisfactory, is folded up and packed for transfer to the airship-building shed.

The outer cover, of linen, is made up into pieces having a width equal to the length between two transverse rings of the hull structure, and a length equal to half the circumference of the section of the framework which they fit. The shape is of course such as to give a correct fit on the ship. The edges are provided with eyelets to take the cords by which the cover-sections are laced to each other and to the frame.

We now come to the erection of the complete airship in the shed, and reach problems entirely different from those met in ordinary engineering, and it will be of interest to describe the system generally adopted for the erection of a rigid airship.

Cradles on which the hull framework of the ship is to be built are first of all erected and carefully lined up. The transverse rings forming the main and intermediate transverse frames of the structure are assembled in horizontal position on trestles on the shed floor. The hull is built up in short sections in a vertical position, each section comprising four transverse rings, and the lengths of longitudinal girders joining them up.

The method of building these rings is first to support two rings at the correct distance apart, and then join these up with longitudinal girders. The section thus erected is then lifted up, and another ring put underneath and joined up with longitudinal girders, the section being thus extended until it is of the maximum size which can be conveniently handled. The bracing wires between the joints and framework are put into position, accurately set up to the proper tension, and then finally fixed.

After completing the section, it is lifted up clear of the floor by means of tackle from the roof of the shed, and then turned over into the horizontal position. It is then transferred to the cradles after being fitted with rollers at each of the main joints, which enables the whole section to be rotated on the runner rails which are fitted to the cradles.

As a series of these sections is completed and transferred to the cradles, they are joined up by putting in place the longitudinals between their adjacent transverse rings, and fitting the necessary wires, etc. To enable this to be done, the sections are rotated in their right relation on the cradles, which enables all work in connection with putting in the joining-up girders and riveting, etc., to be carried out entirely from the stagings erected underneath the hull, thus eliminating all need for work to be carried out on the upper part of the airship with consequent risk of accidents and difficulty of access.

The views on the facing page show features of present-day rigid dirigible construction as follows:

1 Assembling the transverse frames on the floor of the huge airship hangar. 2. A section of the structure as built vertically. 3. Sections of the hull structure on the cradles for joining up. 4 View looking through the interior of the finished hull structure. 5 Structure of one of the "power eggs," the miniature shapes that are assembled on the side of the main hull toward the bottom, to carry the engines, etc. 6 View of the completed keel structure with the gasoline tanks in place. 7 The gasbags being inflated and the outer cover being placed in position.

When all the sections of the hull framework are finished on the cradles, and joining-up is completed, the net wiring—which is fitted on the inner circumference of the framework to take the gasbag pressure—is fitted, and the hull is now finished and is fixed in its normal position, with fabric coverings on the longitudinal girders to obviate chafing of the gasbags against the girders.

The stabilizing fins and rudder planes, which have already been completed, are fitted in position at the aft end of the ship. The navigating and machinery cars are placed in position under the ship, and suspensions and attachments between them and the ship are fitted in position.

The fuel tanks and water-ballast bags are slung in their proper positions in the keel corridor, and all the control wires and gear for the operation of the rudders, water-ballast valves, etc., connected up to the navigating controls in the control car.

When all this work is completed, the gasbags are slung up in position, and when ready, are connected up to the hydrogen supply pipes, and the bags are all gradually filled simultaneously, this operation of gassing the ship usually taking from three to four hours.

As the gasbags are filled, the sheets of outer covering fabric are put into position and laced up. It is very important that the outer cover should be well stretched over the ship, as this not only helps to counteract the internal gas pressure on the hull girders, but the tautness has a very important effect on the resistance and speed of the ship through the air. In order to attain and preserve a suitable tautness of the cover, it is now the practice to dope the fabric after being fitted and stretched in position, which not only tightens the cover and gives it good surface, but also greatly increases the weather-proofness and obviates variation in the tautness of the fabric due to the humidity of the air.

After the outer cover is completed, the gasbags fully inflated, and all the other work on the ship completed, the ship is then ready to undergo what corresponds to the dock trials of a steamship. She is secured floating clear of the floor and sides of the shed, and her engines are run for several hours, driving the propellers, while tests are carried out to ensure that all gears and controls function properly.

At last comes the event to which all responsible for her design and manufacture have long looked forward, namely, the trial flight. The fuel tanks and ballast bags are filled; the crew and observers go aboard; ballast is carefully tested; the shed doors opened; and the handling party lead her out into the open air. A few minutes later, after a final test of her trim and ballasting, she is speeding away, followed by the good wishes of the hundreds who have been engaged on her construction.

Hydroelectric Development in Portugal

IT is reported in the daily newspapers that the Portuguese Minister of Commerce has appointed a commission to study the matter of the utilization of the water power of the rivers of Portugal for the purpose of furnishing hydroelectric power for railway, power, and lighting purposes.

Two engineers, Senhores Fernando de Souza and Vicente Ribeiro, have been nominated by the representatives of the Portuguese National Railways to sit with this committee, which has been created at this time to study these matters principally because the outlook for fueling supplies for Portugal, which possesses no working coal mines, is not at all bright, owing principally to the high prices of imported coal, the present low value of the escudo in the American markets, and the uncertainties as to available coal supplies in producing countries.

In the case of the Portuguese rivers it would be necessary to construct an extensive and likewise expensive system of dams, with a view to conserving enough of the water from the winter rainfall to last through the summer.

The headwaters of the largest Portuguese river, the Douro, are situated across the frontier in Spanish territory, and for this reason, before any definite plans for the utilization of its power can be formulated, it will be necessary for the Portuguese and Spanish Governments to come to some sort of an agreement for the division and distribution of the Douro water, for as matters stand now it is possible for Spaniards having farms in the basin of the upper Douro to divert practically all of its waters for irrigation purposes.

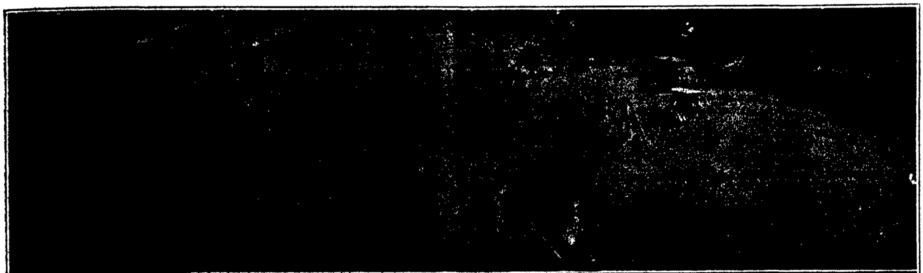
This commission will also be expected to study the question of the utilization of a number of seams of coal which are known to exist in Portugal, and it is even possible that it will study Portugal's petroleum possibilities as well.

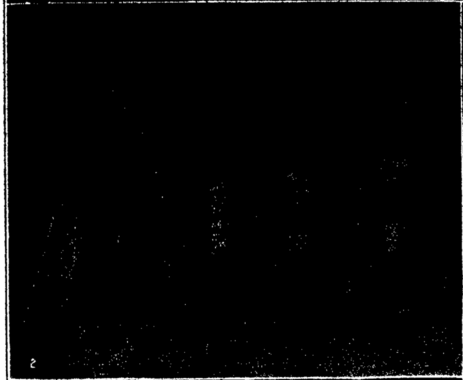
New Record for Unloading Collier

TWELVE thousand and thirty tons of coal were discharged from the collier "Ulysses" at the Cristobal coaling plant of the Panama Canal in 15 hours and 25 minutes on November 12-13. The collier docked at 8:50 A. M., November 12; unloading was begun at 8:55 A. M.; at 12:20 A. M., November 13, the cargo of 12,030 tons had been completely discharged, the ship cleaned up and all men were off. Cleaning up and taking the men off usually requires about an hour.

The discharge was effected by means of the 4 unloaders of the plant, equipped with four 2½-ton clamshell buckets. Four unloaders worked from the beginning until 3 P. M., 3 continued from that hour until 11 P. M., when 2 were discontinued, and the unloading was completed with the use of 1 unloader.

About 6 hours of the work was performed after dark. The new record beats the previous record for discharging the collier at this plant by 6 hours and 10 minutes. The work was rushed in order to allow the ship to return with minimum delay to Newport News for another cargo, as in the present shortage of coal every effort is being made to increase the stock of bunkers.

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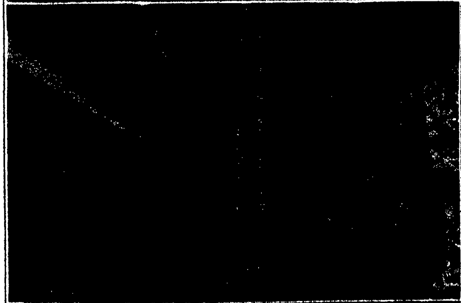
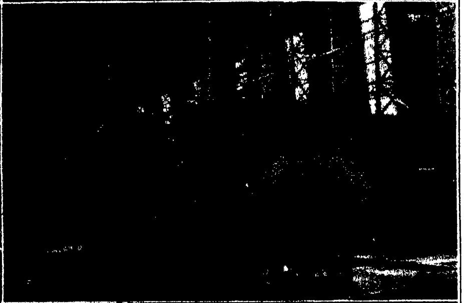
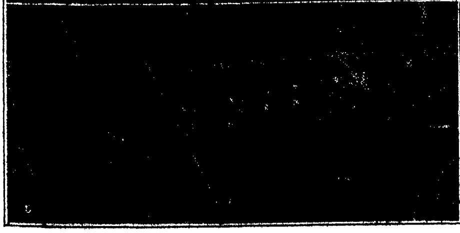
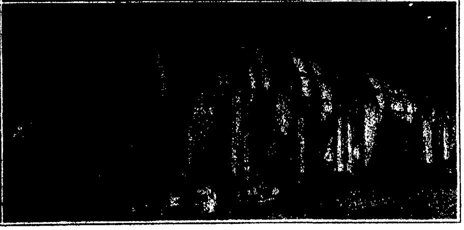








The Story of the Prune

How California Growers Handle Their Crops from the Tree to the Consumer

By G. Orb

IN 1856 a Frenchman, Louis Pellier, brought two prune trees to this country and planted them near San Jose, in Santa Clara County, California These grew; other plantings were made, slowly an industry had its beginning In the early seventies prunes began to be shipped commercially to the States west of the Mississippi; in 1896 a tariff of two cents per pound was placed on foreign prunes imported into this country, thus protecting the little new industry of California And today California produces 90 per cent of all the dried prunes and apricots consumed in the United States and Canada, with an output of something like 200,000,000 pounds per annum

More than half the prunes grown in the whole United States are produced in the Valley of the Santa Clara Here is located what is perhaps the largest deciduous fruit house in the world, packing in different years, according to size and quality of the fruit, from 500 to 900 carloads, all sorted and boxed by experienced hands and shipped to almost every corner of the globe—China, Europe, South America, South Africa, and so on.

In the last days of March or early April the Santa Clara Valley looks like a vast snowfield glistening in the sun—a hundred and twenty-five square miles of vineyards and trees in snow white blossom By late August or early September these blossoms have turned into the ripened fruit, earth and sun and air have completed their wonderful work Not even now does man disturb the completion of this work, for the prune is permitted to ripen and fall from the tree It is never picked, as these last few days on the tree so largely increase the sugar content and hence the value. These prunes may lie on the ground a week or even a bit longer before the women and children come in with basket and pail and begin to pick them up and fill the empty boxes in which the teams haul them through the orchards *Usually, the ground is picked over three times before the end of the season* At the last picking the trees are shaken to bring down all the fruit

From the orchard the prunes are hauled to the dipper and drying ground First they go to the dipper, an iron tank containing about five pounds of lye to 100 gallons of water, which is kept boiling hot The prunes are dipped into this tank for about thirty seconds by means of a wire basket or revolving drum Following removal they are passed under a wire screen with strong jets of clean cold water flowing on them, and washing off all sediment and lye-water They are then spread on trays measuring three by eight feet, ready for the drying ground. The hot lye bath, by the way, has slightly broken the skin of the prune, so that the moisture may the more easily escape in the drying process.

Again the rays of the sun are called upon, for prunes are dried solely by the sun, taking from five to ten days for the completion of this phase. The drying grounds may be twenty or thirty acres in extent. At times there are spread out upon these fields twenty to thirty thousand trays, containing some 2,000,000 pounds of prunes, which when ready for the market would be valued at almost a quarter of a million dollars

Bins in the grower's fruit-house serve to store the sun-cured fruit until it can be sacked and delivered to the packing house. Some seasons, when deliveries can be made prior to September 30th, a premium of one cent a pound is paid and deliveries are made direct from drying ground to packing house. During the last days of September and until the time limit has expired, day and night, a continuous line of trucks and farm wagons unload the new dried prunes at the packing house door. Here they are weighed and tested and then emptied from the sacks on to the carrier which takes them to the grader The floor of this carrier is perforated with holes, and it is kept continuously vibrating for the purpose of sifting out dirt and sticks. From the carrier the prunes are emptied on to the grader proper.

In the twin grader there are two parallel streams of prunes flowing over metal screens that are perforated with holes of increasing size as the prunes progress. As the prunes pass along the perforated screen the small sizes drop through first and the larger ones pass on until they too find an opening of sufficient size to fall through to the bin below. By the time the stream has reached the end of the grader, all prunes have dropped through and have been graded according to size. From these bins wheel-barrows deliver the prunes to the processor. The grading determines the size and hence the price paid to the grower.

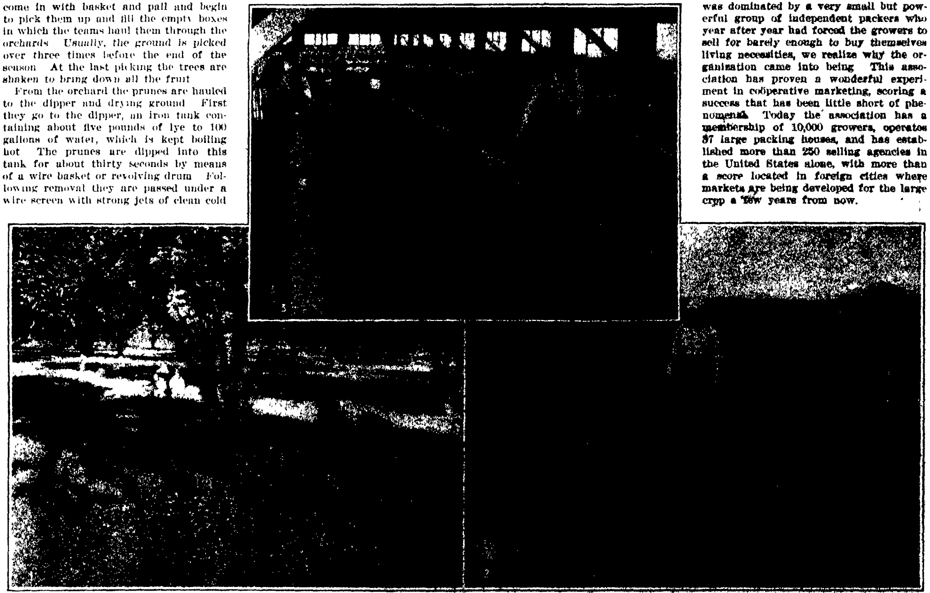
The "processor" prepares the graded fruit for packing. It is boiled or steamed for about three minutes, then run over a screen to drain, and while still warm is emptied into the box or carton, weighed, and the lid clamped on by a high pressure nailing machine. The boxes of fruit are carried to the freight car waiting on the siding.

Apricots are similarly packed except that the pit is removed and that they are not put through the "processor."

The Italian prune is grown in Oregon to the extent of some 25,000,000 pounds per annum. This prune has a tart flavor and is sold to a restricted class of buyers, the Jewish population of our [illegible] American cities buying a large portion of this [illegible].

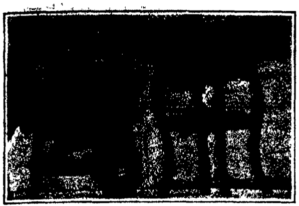
Three and a half years ago—May 1, 1917—a prune and apricot growers' association came into being, purposing to operate a non-profit selling agency which should be strictly coöperative, returning every cent of profit over and above actual cost of operation to the growers whose orchards produced the fruit.

When we know that California produces some 200,000,000 pounds of dried prunes annually, or 90 per cent of all the prunes and apricots consumed in the United States and Canada, and that, prior to May 1, 1917, the marketing of this entire crop was dominated by a very small but powerful group of independent packers who year after year had forced the growers to sell for barely enough to buy themselves living necessities, we realize why the organization came into being This association has proven a wonderful experiment in coöperative marketing, scoring a success that has been little short of phenomenal Today the association has a membership of 10,000 growers, operates 37 large packing houses, and has established more than 250 selling agencies in the United States alone, with more than a score located in foreign cities where markets are being developed for the large crop a few years from now.



1 Prunes are never picked. They ripen on the tree and drop to the ground. Then the whole countryside works from daylight until dark gathering the fruit before it can spoil. 2. Sweating out in a California sun bath Prunes are not dried artificially They are cooked for six days under the rays of the hot September sun. Some of the drying fields hold [illegible] trays at a time, on which are spread a quarter of a million pounds of fruit. 3 Down goes the prune when it comes to the right-sized hole. The customer pays for prunes according to size, hence this grading process.

Some phases of southern California's prune industry, from the tree to the grading process



An unusual chair and table fashioned out of knotty maple wood by a western craftsman

Maple Knot Furniture

OUT in the wildest mountain fastness of Washington lives a man who spends a great part of his time in the forest in searching for particularly knotty trees. He always makes a fortunate find, for the commercial lumber hunter passes by the very kind of tree for which this man is hunting

After the tree is felled it is ripped into workable lengths with a cross-cut saw. The pieces are then cut into shape with a small hand axe Where necessary the essential pieces are fastened together with the most primitive of equipment. The great majority of the pieces of furniture are in a solid state cut and shaped out of a great knot of maple wood The wood, in practically every piece, is so hard that it is impossible to form holes for fastening arms or legs In the rustic oddity of this forest-carved furniture there is a great deal of exceptional artistic taste and the sturdy ruggedness of the chairs and tables this man has made give them splendid adaptability to a mountain house

The illustration above shows a rocking chair and a table made out of knotty maple wood. Note how the craftsman has worked in odd pieces of wood in order to give graceful lines as well as the desired grain effect. The rockers of the chair and the legs of the table are, of course, carefully shaped so as to give the necessary strength to the furniture.

Freaks of the Vegetable World

THE two specimens presented in the accompanying illustrations are very unusual freaks of the vegetable world It is not such a rare occurrence to come across a potato or carrot or other vegetable which bears a striking resemblance to the human head or body, but the present specimens are exceptionally interesting

The first or upper illustration shows a strange monster which suggests a reptile of antediluvian days. Yet it is nothing more than an ordinary yam, or sweet potato. This freak tuber was raised on a farm near Cairo, Ill., and measures 18 inches long

Obviously, the eyes and mouth have been added to emphasize the monster-like appearance of the potato, but the carrot has not been altered

The second or lower illustration shows a freak carrot which grew in a startling way It bears a most striking resemblance to the human hand, which is shown beside it by way of comparison

Two freaks of the vegetable world: A sweet potato resembling a gila monster, and a carrot shaped like a hand

Where Is That Forest Fire?

WITH thousands upon thousands of acres of dense forest land to contend with, the location of a forest fire by the forest rangers would at first thought appear to be a complicated matter Yet such is not the case The forest officer depicted in the accompanying illustration is locating a forest fire by means of alidade and segmented circle Two or more stations equipped with such finders report to a central office the angle upon which they locate the smoke Intersecting lines on a master map, orientized with those in use by the lookout men, give the exact location of the blaze

Observing Currents from High in Air

THE individuals shown in the accompanying view are not performing acrobatic stunts nor suspended from earth by reason of their eccentric modes of living. They are observers at a cable gaging station constructed in Bolivar County, Miss Moreover, these experiments were designed to test the well-known formula of Kutter as the accepted standard for determining the flow of water in open channels

The experiments were conducted under the guidance of the Drainage Division of the U. S. Bureau of Public Roads, and when supplemented by a study negotiated by the engineers of the Miami Conservancy District of Ohio, the conclusion is "Although the Kutter formula is not ideal it is the best equation available at the present time" The field velocity measurements in Mississippi were made with a small Price current meter The measurements were obtained at intervals of 2½ feet across the streams for the smallest channels, 5 feet for the medium-sized cuts, and 10 feet for the largest ditches The velocity, at the measuring points, was obtained at the surface, mid-depth, and bottom of the stream

A cable gaging station on the Mississippi River for measuring the rate of flow

Experiments similar to the one in Mississippi were conducted in Tennessee, North Carolina, Iowa, and Florida. Among the conclusions announced as of value to engineers in the study of the flow of water in dredged drainage ditches are: A deposit of slimy silt on the sides and bottoms of a channel substantially lessens frictional resistance to flow clearance of ever-growing vegetation or shrubbery from a channel will perceptibly enhance its capacity, an accumulation of débris, trees, logs, and other obstructions in a ditch will greatly decrease its capacity, a dredged channel rapidly deteriorates in hydraulic efficiency unless systematically maintained, abrupt variations in a cross section play no inconspicuous part in minimizing the hydraulic efficiency of a ditch; after a certain amount of erosion has taken place in the ditch continued wearing action does not necessarily increase the roughness of the perimeter.

Engineers and other parties interested in a detailed discussion of the results of experiments relating to the subject of the flow of water in dredged drainage ditches should apply to the United States Bureau of Public Roads, Washington, D C, requesting a copy of a professional paper written by C E Ramser, senior drainage engineer.

Spotting Whale Meat in Sausage

AS a subterfuge whale meat cannot be mixed with beef and pork in the composition of sausage without its presence being revealed by chemical analysis, according to a formula worked out by the meat inspection laboratories of the Bureau of Animal Industry. The fat of the whale and other marine products varies from that of cattle, hogs, sheep, and other land animals in essential particulars, chief of which is the presence of the glycerides of highly unsaturated fatty acids. This ingredient has the capacity of joining with bromine in forming highly insoluble compounds Glycerides are evident to a substantial degree in whale fat but are not found in meat animals or vegetable oils.

A forest officer locating a forest fire with alidade and segmented circle

The method developed by the meat inspection of the Federal Government for the detection of whale meat in sausage had its origin in an experiment with a mixture of canned whale meat and Frankfurter sausage The marine product had been cooked before canning and there was an absence of visible fat, while the Frankfurter sausage used was an ordinary sample The test specimen contained 20 per cent whale meat, which was shredded finely and incorporated intimately with the sausage Sixty grams of the mixture were then extracted with ether, the product having contact with ether for two or three hours The ether was then filtered off, and evaporated on the steam bath, the fat obtained being examined by the following method used by the Bureau of Chemistry in detecting the presence of whale and fish oils in vegetable oils

"Dissolve in a test tube about 6 grams of the oil in 12 centimeters of a mixture of equal parts of chloroform and glacial acetic acid Add bromine, drop by drop, until a slight excess is indicated by the color, keeping the solution at about 20 degrees Centigrade Allow to stand 15 minutes or more and then place the test tube in boiling water If only vegetable oils are present the solution will become clear, while if fish oils are present the solution remains cloudy or contains a precipitate due to the presence of insoluble bromides"

A positive result was obtained in the initial experiment, the solution remaining cloudy in the boiling water and deposited a good precipitate of insoluble bromides after standing for a brief period of time The conclusion is that even a minute portion of whale meat cannot be incorporated in beef or pork in making sausage when subjected to the searching eye of the chemist

The Story Behind the Locked Antlers

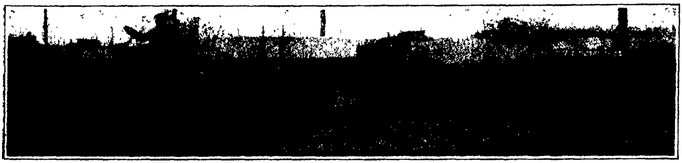
OUT of the files of the U S Forest Service comes this interesting photograph of a pair of locked deer heads It appears that these deer fought near Fremont Lake, in the Bridger National Forest, Wyoming, got their horns locked together and were drowned by falling into the lake These locked antlers were cut out of solid ice by U S Foresters

A pair of locked antlers which tell their own story of a fight to the finish

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M S A E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Trucks and trailers carry a heavy load of stone without exerting too much wear on the road. It is the large wheel-contact area and the distribution of the load that count, not the gross weight of the train or the individual vehicle

Truck-Weight Legislation

THE permissible weight of the load on the road should be determined on the basis of width of tires, and not by legislative whims Routes between large cities or the important commercial and industrial centers serve an enormous tonnage, and the larger the units in which this tonnage is hauled the greater the economy of hauling These routes are main arteries of traffic, and anything which increases the cost of transportation on them is paid for by all the people, regardless of how far they may be from these main arteries When it is taken into consideration that 50 per cent increase in the size of the unit hauled makes a 15 per cent decrease in the cost of transportation the matter becomes one of great economic importance with tonnage running up into the millions

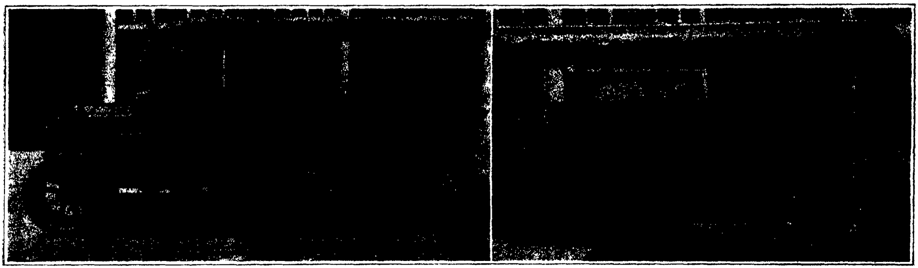
On roads of reasonably good construction the weight is fully taken care of by the 800-pound limit per inch of tire width For every 800 pounds of increased wheel load, an inch is added to the bearing surface of the tires With the addition of a trailer the weight of the load can be doubled without doubling the strain on the road You simply add to the wheel base The load, while greater, is distributed over more wheels of proportionate tire width A striking illustration of this is given by our railroads While heavy rolling stock such as the big compound engines which are now used on our railroads, are very much heavier than the rolling stock of years ago, the weight per inch of bearing surface has not been greatly increased This has been met by putting extra bearing surface under the weight For instance,

(Continued on page 60)

Truck Compressor Tests Natural Gas

TAKING the gasoline out of natural gas by compression is the unique job of the model ¾-ton truck built with special transmission and power take-off for a large oil company of Tulsa, Okla Comprising a miniature compression plant capable of developing a pressure of 300 pounds, the apparatus on the truck is used to test natural gas as it comes from the wells, with a view to determining its gasoline content "Casing head gasoline"—the gasoline product resulting when gasoline is taken out of natural gas by compression—is produced at several plants maintained by the oil company using the equipment illustrated, but before gas from new wells is piped to a plant, its gasoline content is determined to make sure that the quantity of gasoline per thousand cubic feet of gas will make it profitable to run it through the plant Then, too, gas from wells already piped through plants is tested by the truck-compressor unit at frequent intervals as a check on their productivity

Attached to a reel at the rear of the truck, on the right side, is a rubber hose to reach from the truck to the gas line to be tested The hose attached to the well, gas passes through it and into a manometer, which indicates the pressure of the gas at the well Next passing through a meter, the gas is measured Then it goes through the compressor, passes into a condenser and finally accumulates in a small cylinder which extends below the truck body just forward of the rear spring A gage glass shows the cubic centimeters of gasoline. From this test, the operator is able to calculate the amount of gasoline which a given quantity of gas will produce. With its special transmission and power take-off, the truck can be driven over the road with power take-off intact, yet not in use. When it is desired to drive the apparatus, the mere shifting of a lever puts the machinery in motion with the full power of the motor applied. Any one of the four gear reductions in the transmission may be used. Thus the operator is given a wide range of speed and power without the necessity of making any mechanical adjustments in the truck when it is changed from road work to driving machinery.



Light truck provided with testing equipment for natural gas, and a closer view of this apparatus in operation

The Short Haul Problem

WHEN we look at the picture presented by our railroad situation today we are indeed startled. Our 2,400,000 freight cars carry only about one-half their capacity and move about 25 miles per day per car. Box cars average something over 35 tons capacity, and yet hundreds of thousands of them are carrying less-than-carload freight, and hauling perhaps not more than 5 tons. While it is impossible to give the exact figures we have a record of one investigation of the Cleveland, Cincinnati, Chicago & St Louis Railway in which it was found that the average less-than-carload loading for a certain six months operation was about 5 tons. Nearly one-half of all the tonnage carried in the Eastern district is coal, according to reports in the *Transportation World*.

Very few records are kept by railroads

(Continued on page 60)

Part of a fleet of 7½-ton trucks in regular operation between Wilkesbarre and local Pennsylvania points, and Newark, Paterson and New York, giving a service which the railroad cannot approach, and at less cost

Canada's Niagara Development

(Continued from page 44)

rock section; but walls are erected on the margins of the rock section and carried up a distance. These are filled in on the rear. At another point, yet farther north, the canal bed is a very flat V. Near the power-house, where the excavation is practically all in rock, the section is substantially a simple rectangle.

In rock excavation, we are mostly familiar with the rock drill and the blast as a means of removing the material But on this work, the channeling machine has found opportunity for service The more familiar method is also in use, but channeling seems to be in favor, especially in the upper part of a rock excavation This machine is much used in certain quarries, doubtless because of the smooth vertical face that it leaves

Naturally, the steam shovel is greatly in evidence, especially on this canal work, cutting down through the overlying soil or removing spoil in the rock portion What is claimed as the greatest steam shovel in the world is captain of the Hydroelectric Commission's battery It is an American-built machine. This fellow is so big that it is thought advantageous to send a smaller shovel ahead as a pilot The latter makes a preliminary cut, and the giant then tackles the job.

Quite a variety of excavating apparatus has already been in use on this development. The cable-way excavator, the dredge, the steam shovel, the rock drill, and the channeling machine may be cited as among the principal types The cable-ways work both in the dry on the canal proper and in the wet along the Welland River. Such cable-ways may be very advantageously used where it is possible to arrange parallel tracks along the two sides of the proposed excavation On these tracks the head and tail towers may be shifted from time to time. The excavating may be carried on, as in the present case, with the aid of the clam-shell type of grab bucket. A heavy cable stretched from tower to tower provides a track on which a carriage may be hauled out and in by means of suitable lines operated by a hoisting engine at the head tower A close examination of the head towers in the photograph will show that the track consists of four rails—a double track, in fact.

The channelling machine, much used upon this Canadian work, is a device which cuts a deep and narrow vertical slot in the rock In the quarrying of sandstone and marble, especially where the stone itself is valuable or where it is desired to cut the stone to specified rectangular dimensions, this type of machine is very useful indeed. But channelers have been used in plain engineering enterprises, where a vertical face is required, at least as far back as the time of the construction of the Chicago Drainage Canal. They have been employed on the New York Barge Canal.

A typical channeling machine is an apparatus mounted on small wheels which are adapted to run on a track. A steam boiler on board supplies steam to a vertical cylinder. A piston in the cylinder is made to travel up and down and by means of its rod and a cross-head on the rod to carry up and down a cutting tool. The cutting tool may be of various types A typical cutting bar is 34 inches long and will cut down, into the rock until the slot is 18 inches deep. The bars are used in longer and longer lengths as the cut deepens. A tool of maximum length used on a representative machine will cut to a depth of perhaps 7 feet. A channeling machine operates by making a multitude of percussive blows per minute; 200 per minute is not to be considered unusual The steel tools used in cutting vary greatly, the variations taking especial account of the particular rock in hand. Thus, the tool may for soft rock consist of as many as five steels each with its cutting

(Continued on page 57)

Starrett
Hack Saw Chart
THE L. S. STARRETT CO., ATHOL, MASS., U. S. A.

Do you choose a hack saw for appearance-or performance?

Hacksaws all look about alike. Weight, teeth, thickness and finish seem to be similar. The difference is in their performance.

No matter how good the saw may be it's certain that the blade made to cut soft metal won't cut cold rolled stock. There's no such thing as a hacksaw capable of cutting all materials equally well. Fact is, there's only one way to be sure of the right blade and that's by the hacksaw chart.

Picking the right blade for the particular kind or shape of metal is easy if you use Starrett saws according to the Starrett Hacksaw Chart.

We will be pleased to mail you a copy of the chart. Free. Also ask for Catalog No. 22 "B."

THE L. S. STARRETT COMPANY
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Use Starrett Hack Saws

Getting the Most Out of the Right Saw

In the small shop, where hand sawing is done and each man owns his own frame, and where but few pieces of different materials are cut from time to time, a change in blades is naturally out of the question for each change in the material. Hence the convenience of a blade like the No. 103 (see Chart on pages 22 and 23), that will in a degree meet all ordinary requirements. But there are few mechanics, who, under even these conditions, cannot at times work to better advantage with a flexible back blade, like the No. 250, which has 18 teeth, or who do not sometimes require a finer tooth blade, like the No 258, with 32 teeth to the inch, for cutting thin sheet metal. In the end, time will be saved and inconvenience avoided if these saws are kept strained up in separate frames, so that one can be picked up and used instantly The man who will thus equip himself may generally be relied upon to use with discretion the various blades furnished to him, but wisdom should be exercised in their selection and purchase

Each Man Should Have a Chart

Whatever saws are adopted as the standard, a Hack Saw Chart, based on that make of saw, should be established as the basis of selection for the work in hand Not only should the tool or stockroom from which the saws are issued be provided with these charts, but definite control should be maintained over the delivery of saws of a given number, according to the requirements of the work and the machine, where power saws are used Each workman, in turn, should have a copy of the chart, perhaps somewhat modified, so that he, too, may know the blade which is best suited for each class of material

Should Carry Complete Line

To meet the requirements of different classes of work by the selection of the blade designed for that work, to increase thereby the individual efficiency of each saw and reduce the total number of blades required, it is obvious that a complete line should be carried It is better to carry and issue exactly the right saw for unusual and intermittent requirements, than to do the work inefficiently for lack of the proper blade —From *Hack Saws and Their Use*, published by The L S Starrett Co., Athol, Mass., for free distribution

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of General Interest

TRAFFIC SIGNALING DEVICE.—J Selligman, c/o Marion Co, Taylor Bldg., Louisville, Ky The invention has for its object to provide a device especially adapted for use in cities for controlling traffic at street intersections, wherein the signal is supported by overhead means, permitting the usual standard to be dispensed with, and wherein it may be operated from the center of the street, so that it is not necessary to remove the signal when the rush hours are passed

TYPEWRITER DESK —W F. Olson, 136 N 31st St, Omaha, Neb An object of the invention is to provide a desk having a central channel in which a typewritten supporting platform is movable and adapted to move rearwardly into a housing with a trap door covering the channel and held in closed position when the typewriter is not in use The desk provides ample smoot surface for the distribution and support of papers when the typewriter is not in use

NAME PLATE —A Tobias, Room 914, 41 Union Sq, New York, N Y Among the objects of the invention is to provide means for removably supporting letters and other characters of any sort which permits the ready assembling of any name or sign and enables the interchange of letters or characters from time to time as may be desired A further object is to provide a name plate which will be neat and attractive and which can be manufactured at an extremely low price

ADVERTISING DEVICE. L F Trevali Johannesburg, Transvaal South Africa This invention has reference to apparatus for exhibiting pictures, particularly such as are used for advertising, in which the exhibited picture is periodically and automatically changed The apparatus presents a picture for a period causes it to fade out and then again brings a picture (usually the next of a series) into view in the reverse manner

STAIR CARPET RETAINER — W W Phillips, Frankford Del Among the objects of this invention is to provide a retainer for stair carpets that will be held in place with more reliability and so will hold the carpet more securely in proper alinement than in any previous device, by reason of certain auxiliary metallic attachments to the main holding device

REPAIR DEVICE —M Rodgers 26 E 42nd St New York, N Y The invention relates to an apparatus for repairing flexible tubes in footballs, basket balls, and other inflatable bodies having internally of their cover what is commonly called a 'bladder' said bladder being inflated by means of a flexible tube It is an object of the invention to provide means by the use of which tubes of the above mentioned character may be readily applied or repaired

FOOD PRODUCT — Mari Broch, 377 Richmond Turnpike Stapleton, L I N Y An object of this invention is to provide a palatable and nutritious food product consisting of tomatoes and eggs mixed together to produce a liquid material, flour added to this and thoroughly worked and kneaded to produce a paste or dough of thin strips, and finally cut into pieces of suitable size to be uniformly dried

COFFEE OR TEA POT —J Heinrichs, 948 Broadway, New York, N Y Among the objects of the invention is to provide a simple coffee or tea pot arranged to insure an effective percolation of boiling water through the coffee grounds or tea leaves and without danger of particles passing through the filtrate into the pot, and to permit of the use of a cheap filtering medium, such as filtering paper or the like, which can be readily thrown away after being used

BOAT —G F Brunies 263 Flatbush Ave, Brooklyn, N Y The invention aims more particularly to provide a plan and knock down construction from which a child may be enabled to build a boat which shall be capable of sailing and shall reproduce as nearly as possible the maneuvers of a full size sailing boat, having all the essential parts of an actual sailing craft, the construction being adaptable to a full size boat

CASHIER PROTECTOR —E J Carroli, 135 W 49th St, New York, N Y. An object of the invention is to provide a shield which is preferably bullet proof and which is normally hid from view, but which may be moved quickly into position to protect the cashier from a burglar in front of his window or desk The device is brought into operative position by spring pressure and foot release

ASH SIFTER —R. Mason, 10 Cowen St, Saratoga Springs, N Y This invention has for its object to provide a manually operated ash sifter which facilitates the sifting of the ashes and the ready discharge of the cinders A further object is to provide an ash sifter which will be practically dustless, which will be convenient to operate, and which can be manufactured and sold at a reasonably low price

COMBINED WINDOW SCREEN AND VENTILATOR —C F. A. Cammann, 511 W 172nd St, New York, N Y The invention has for its object to provide a window screen and ventilator more especially designed for use on windows of bathrooms, bedrooms, etc, and arranged to insure the desired ventilation and at the same time prevent outsiders from peeping into the room Other objects are to insure the admission of fresh air without draft, to prevent rain or snow passing into the room, and to permit the user to conveniently attach the device to a window

SHOE CLEANING AND IRONING JACK — H G Benoix and P J Speccy, 195 Lefferts Ave, Brooklyn, N Y The invention has particular reference to supports for holding shoes, slippers or the like for the purpose of cleaning or dressing them Among the objects is to provide a shoe holding jack that is adapted to directly receive and support a shoe when carried by any conventional last, the means for holding the last and shoe thereon being easily operated

Machines and Mechanical Devices

DRYING MACHINE —J L Pierce, 223 Kneedler Bldg Manila, Philippine Islands The invention relates particularly to a machine for drying copra, fish vegetables and other food products in preparation for shipment and for market A purpose is to employ a conveyor device within a heating or drying chamber said conveyor embodying a carrying section and turning means for carrying and turning the material through the drying chamber to be dried

Medical Devices

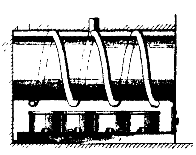
DENTAL TOOL —I Gonzalez, 45 West End Ave, New York, N Y The object of the invention is to provide a dental tool in the form of a drilling machine, including in combination with the conventional chuck of a mechanically driven tool and operating stem of said chuck, means adapted to be removably associated with the chuck, and to engage the operating stem for permitting a manual rotation of the latter

Musical Devices

MUSICAL NOTATION —F Taft, 152 Gates Ave, Monticello, N J Among the objects of the invention is to provide a musical notation arranged to enable a person unfamiliar with the usual written or printed score of a musical composition to readily locate the keys and execute the composition on a piano, organ or other keyboard controlled musical instrument without danger of confusing the player

Prime Movers and Their Accessories

COMBINATION DEVICE.—S Young, La Condamine St 101, Rio Amazonas, Yquitos, Peru This invention has for its object to provide mechanism of the character specified, for permitting the utilization of fuel in the form of shavings, paper, straw, slack and the like, and for insuring the complete combustion of the same, and for conserving all the heat generated during combustion.



A SIDE VIEW OF THE DEVICE WITH PARTS IN SECTION

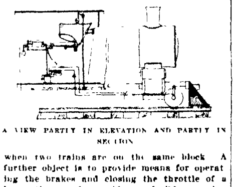
ENGINE.—W K Edgar, 1821 S. 13th St, St. Joseph, Mo. The invention relates more particularly to two-cycle internal combustion engines of a kind adapted for use in aviation and of various other kinds in which simplicity of construction, efficiency in action and compactness in building are desirable factors. The purpose of the invention is to provide for compression of the explosive mixture at the same stroke of the piston which is incidental to the exhaust

ENGINE —W K Edgar, St Joseph, Mo. The invention relates to engines generally, and more particularly to two cycle internal combustion engines of a kind adapted for use in aviation, and various other ways in which simplicity of construction and compactness in building are desirable factors The purpose is to simplify the mechanism and to provide for compression of the explosive mixture at the same stroke of the piston which is incidental to the exhaust

Railways and Their Accessories

RAILROAD SIGNAL DEVICE —C J Chamales, 1246 Hood Ave Chicago, Ill. Among the objects of the invention is to provide a device which will indicate to the engineer of a train his location, as for instance when the train is approaching a bend in the track which should be taken at a low speed, by operating an audible signal in the cab of the engine. The device is actuated by auxiliary track devices not subject to the difficulties that attend signaling devices operated by making electrical contact with track devices

TRAIN STOP MECHANISM.—J McManus, Jet, Okla An object of the invention is to provide electrically controlled means for preventing train collisions and which is so constructed as to automatically stop both trains when two trains are on the same block A further object is to provide means for operating the brakes and closing the throttle of a locomotive, and provide a fusible member burned by the explosion of gasoline which is ignited by a spark caused by the closing of an electric circuit when the two trains are on the same block



A VIEW PARTLY IN ELEVATION AND PARTLY IN SECTION

Pertaining to Recreation

SWING —A A Wall, 1510 Gates Ave, Brooklyn, N Y The invention relates to swings accommodating two persons seated opposite each other The object is to provide a swing arranged to enable the user or users to readily set the swing in motion without requiring undue physical exertion Another object is to provide a swing which is strong and not liable to get out of order easily

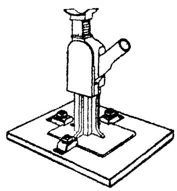
PLEASURE RAILWAY —F. A Smith, 260 W 125th St, New York, N. Y The object of the invention is to provide a pleasure railway for use in parks, exhibition grounds and other pleasure resorts, and arranged to provide an exceedingly exhilarating ride for the passengers and amusement for the onlookers. A further object is to provide a long ride within a comparatively small space

Pertaining to Vehicles

TANK ATTACHMENT —C Hebing, 72 Arlington Ave, Mariners Harbor, S I., N. Y. The invention has particular reference to means for establishing communication between the tank and the full feed conduit. The primary object being to provide means for warning the driver of a motor vehicle before the fuel contained in the tank has been completely exhausted, so that he may reach a filling station before the fuel is entirely used up.

TIRE —C W Strauber, 664 E. 166th St, Bronx, N. Y An object of the invention is to provide a vehicle tire of the single tube type so constructed as to form a closed air chamber without the necessity of employing an inner tube It is a purpose to provide a single pneumatic tire which will eliminate the usual trouble and expense of repairing the rubber inner tubes so prevalent in ordinary pneumatic tires.

BASE FOR JACKS.—A. E. Hutchison and H. Krah, 872 Monroe St., Brooklyn, N. Y. This invention pertains more particularly to lifting jacks especially employed as an accessory of motor vehicles. In jacks of this type difficulty has been experienced in maintaining the jack in true vertical alinement during the lifting operation. In this device a rigid base is provided, capable of removal, and with securing means which may be adjusted with respect to the base.



A PERSPECTIVE VIEW, SHOWING THE JACK IN PLACE UPON THE BASE

RESILIENT TIRE —D. S. Kennedy, 457 E 167th St, Bronx, N Y. The general object of the invention is to provide a resilient element to be placed in the tire shoe and extend about the same, together with means for expanding the element firmly against the tire at the sides as well as at the tread or for releasing the tension of said spring element for its insertion or removal.

SIGNALING DEVICE.—A H Barr, 1822 Poli St., Ventura, Cal. The object of the invention is to provide a device adapted for use on motor vehicles, to indicate to following vehicles, and to those in front, the intentions of the driver as regards turning and stopping, the mechanism being provided at the front and rear of the car, and under control of the driver at the wheel.

POWER DEVICE.—S Beer, Genl Delivery, Sacramento, Cal The invention relates to a device adapted to be driven by the drive wheels of an automobile, an object being to provide a device which can be quickly assembled and taken apart and can thus be easily transported from place to place. A further object is to provide a device which is so constructed that a car can be conveniently run into operative position

Designs

DESIGN FOR LACE.—H. Baechtold, 1270 Broadway, New York, N Y

DESIGN FOR AN ARTICLE OF MANUFACTURE.—D. C. Frank, 28th St and 4th Ave., New York, N. Y.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—G. Gould, McKenney, Texas.

DESIGN FOR A CALENDAR FRONT.—A. J. McDade, 63 Park Row, World Bldg., New York, N. Y.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—H. T. Mendelsohn, 40 W. 25th St., New York, N. Y. The invention has been granted patents of two designs of a similar nature.

DESIGN FOR A PLAQUE OR PANEL.—M Shapiro, c/o Metropolis Metal Spinning Co, Inc., 247 Center St., New York, N. Y.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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Canada's Niagara Development

(*Continued from page 55*)

edge and all held securely in the crosshead. Some of the edges may make a transverse cut, while others in between make diagonal cuts, the whole combined cut being a kind of zig-zag. The tool may consist thus of a gang of steels, but it may also consist of a single steel with a Z-form of cutting edge

Of course, the excavation is not comparable to that at the Panama Canal At the same time, the amount of rock and earth that must be removed is very considerable On the section between the Niagara River and the control works, the earth excavation in the Welland River bed totals about 3,500,000 cubic yards A large part of this work is wet excavation A dipper dredge has been operating in the Welland River bed, depositing its spoil into scows These are being dumped out in the Niagara River A cable-way is also a means of excavating

Several considerable concrete bridges are included in the general undertaking One carries the Wabash Railway across the canal. It is finished, so also are one or two others.

The power-house is at the foot of a steep incline. The initial equipment is to consist of two big 55,000-horsepower turbines and their corresponding electric generators The forebay on the ledge above reaches back along the canal for a distance of 1,000 feet That is, the canal is widened to form this little lake, which is 300 feet wide at its intake end It delivers water to the penstocks, which are big steel pipes 14 feet in diameter and some 450 feet long Four main penstocks and one exciter penstock constitute the initial equipment for serving the power-house Taking the head at the full amount of 305 feet, the pressure, neglecting friction, at the bottom of the penstocks will be about 132 pounds per square inch There is, however, nothing remarkable in this pressure considered alone, but the combination with big diameter means a large mass of water confined under considerable pressure

Fifth Avenue's Traffic Tower

(*Continued from page 45*)

his *locus operandi* in the tower itself This not alone puts his signals where all his subordinates can see them but it at the same time gives him an unrestricted view of the entire length of the avenue Ordinarily the change from north south to east-west traffic is made on a fixed timetable, allowing from 40 seconds to two minutes for each according to the time of day, etc ; but it frequently happens that special conditions somewhere along the avenue make it advisable to modify this schedule Just as an instance, if there were a minor wreck on the avenue itself which it was plain could be cleared away in five minutes it might well be the best procedure to close traffic on the avenue at the point affected for this period Without the *signal tower* and the central administration of traffic, this would involve a frightful congestion in the immediate vicinity of the accident, with it the entire avenue could be kept closed for the time necessary and the congestion distributed to a surprising degree

The pedestrian traffic at big crossings like that of Fifth Avenue and 42nd Street is always a nuisance and a problem The man on foot cannot, apparently, be made to believe that traffic regulations apply to him. He visualizes them as for the vehicle alone, and feels that he is free to cross wherever and whenever he can, dodging about among the cars until he attains his objective at the far curb. It was recognized from the start that the success of the whole plan of central regulation would depend, as much as upon any other one factor, upon the degree to which the pedestrian could be prevented from slowing up the vehicular movement in this way at the Big Corner, the heart of the system. So here we find always four

"The child is an angel, dependent on man"—COUNT DE MAISTRE

Call of the Children

It is, indeed, true that the children, even more than the mother, is dependent on the father, who must recognize this by making due provision for the little ones in case he is called away

This he generally does through insurance protection and many fathers have made and are making such provision by arranging a policy in the

Postal Life Insurance Company

Insurance in force, $42,000,000
Policy Reserves Required by Law (Last Quarterly Statement), $9,241,954.00
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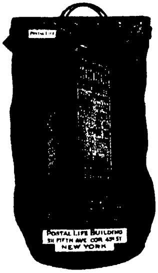
Total Resources more than $10,000,000 00

The contract thus taken out is approved by the State Insurance Department and may be Whole-Life Limited-Payment Life, Endowment Joint Life, Child's Welfare or a Monthly Income policy under which the Company pays a stated sum each month, generally to the mother, to take care of the children when they are growing up, and in many cases the mother herself takes out insurance for their protection

In either case the Policy wisely provides

Help When Most Needed



The result is that the father and mother who thus look out for their family can not fail to be always held by them in grateful remembrance, while those who fail thus to provide – well –it is enough to say that hardly any situation could be more serious

It is well worth your while to have the POSTAL tell you about the different policy-contracts that can be issued as

Protection for Those Near and Dear to You

Call at the Company's office or write as follows.

"Please mail me insurance information as mentioned in the Scientific American for Jan 15, 1921"

And in your first letter be sure to give

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2. Your Occupation
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At more than twenty-two thousand garages, in town and country, empty Prest-O-Lite Gas Tanks may be exchanged for full ones.

Our complete line of appliances using only Prest-O-Lite Gas and air suitable for soldering, brazing, paint burning, etc., is extensively used by manufacturers and in repair shops everywhere.

Light for your truck

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The Gas of a Thousand Uses

IT'S ECONOMICAL

THE initial cost of installing Prest O-Lite Gas equipment is small Any man who can handle a wrench can do the job in a few minutes and once a Prest-O-Lite outfit is in place it will outlast the sturdiest truck Our exchange system makes the cost of operation extremely low

IT'S DEPENDABLE

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or more officers on the street level, one or more on each of the four corners; and after a little preliminary skirmishing during the first week or two, the walkers have been educated to the fact that here is one place in the world where they move with the traffic, and stop when it stops

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Sunshine and Balloon Silk

(*Continued from page 45*)

which, in turn, was affixed to the declination axis The telescope tube supporting the collimating lens could be rotated a small amount and clamped, thus permitting minor adjustments of the spectrum upon the thermopile receiver A black flannel cloth was laid over the spectrograph in barring stray light while observing the sun A specially constructed thermopile was employed in the unit for taking solar-radiation-intensity measurements, which consisted of nine couples of bismuth silver, with receivers 1 1 by 3 millimeters, the dimensions of the entire receiver being 3 by 9 5 millimeters The bismuth wire, 0 1 millimeter in diameter, was flattened as a method of obtaining adequate contact with the receivers. Thereby the time element in attaining thermal equilibrium was reduced, consuming only 10 or 12 seconds

The height of the spectrometer slit was 3 millimeters, and although the spectrum was of only an equal height, the intensity was adequate for making accurate measurements Such a condition was partly attributable to the fact that the length of the spectrum, falling upon the thermopile, was 8 millimeters, sufficient to intercept the whole of the visible, and also the whole of the infra-red spectrum, each in one setting, and the ultra-violet spectrum in two settings The electric current generated by the thermopile, on exposure to radiation, was measured by a sensitive galvanometer

The data were obtained primarily for the purpose of ascertaining the different components relative to that of the quartz-mercury arc lamp Solar radiation is variable as can be assumed from these tests A low-hanging haze, or smoke, on a September day rendered invisible the Soldiers' Home Building three miles away, later on the same day the sky cleared and the ultra violet light doubled its intensity Subsequent to a rainy period of several days' duration, when the sky was extremely clear, the ultra-violet component was 2 per cent of the total radiation intensity Experiments during the early morning hours showed that in consequence of increased scattering of light the ultra-violet component radiation intensity is only approximately one-half that which obtains at noon-day. The reverse condition prevails with respect to infra-red component, which is greatest in the morning and evening, and is a minimum at noon This is explained by the accepted theory of the scattering of light of short wave lengths. Coupled with the invention of this new government instrument for studying the sun and the variation in the intensity of the ultra-violet radiation, valuable meteorological data may be obtained from a comprehensive investigation of the subject.

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The Romance of Invention—XIX

(Continued from page 46)

or armies, or battleships," he contends, "it is necessary to consider only their relative abilities to do damage to each other and defend each himself against the other. No reference to extraneous force can be permitted in a truly fair comparison, because if extraneous force be admitted as an argument on one side, it is necessarily permissible to have the same admission on the other side. Thus, in considering whether or not the battleship can defend itself against the torpedo plane, it is not admissible to say 'the battleship can have a guard of sea-planes, which will arise to meet the torpedo plane in the air and demolish it before it can attack'; because the proponent of the torpedo plane may equally provide the mother ship of the torpedo plane with a flock of fighting planes to arise and go forth with the torpedo plane to give battle to the planes which come from the battleship. We have then staged an aerial battle, the result of which may fall to either contender; and meanwhile we are where we were in the first place; there are a torpedo plane and a battleship left over to fight it out, while the defenders of the one and protectors of the other do their parts in the air.

"It is not easily seen how a battleship can protect itself from the attack of a torpedo plane. The battleship is protected from ordinary torpedo attack by destroyers, smoke screens, and similar fighting or protecting devices, all of the same class of speed and all on the same location-plane in space, as the thing to be protected A destroyer may be twice as fast as a battleship but not ten or fifteen times as fast A destroyer cannot get up in the air and fly. And a destroyer is a target for a naval gun.

"A torpedo plane may attack without being noted until too late. At a high altitude it is invisible and inaudible It can see, but cannot be seen. It can descend so swiftly that it cannot be hit, even if seen It can come within close range of the battleship, launch its torpedo and swoop upward again so rapidly that it is practically safe. Even if it were not safe, what is one man, one inexpensive plane against the loss of a great ship?"

In other words, Admiral Fiske believes that the strong and basic patent given him in 1912 is for an invention not only of a new device for waging war, but of a new system of warfare, and that more than one instance in the late war shows that a torpedo plane may destroy a ship and escape, as a Turkish vessel was torpedoed by a British aviator launching a torpedo from his air craft, and the British ship "Gena" was sunk by a torpedo discharged by a German plane near Suffolk, England.

A great distinction exists between bomb-dropping and torpedo planing, which must be well visualized before any argument is undertaken as to the value of the torpedo plane in wars which may come. The bomb dropper, to be at all effective, must actually hit the thing on which he drops his deadly egg or fall exceedingly close. In the case of a battleship, this is a rather narrow target; and in spite of the accuracy of the aiming device, there is always the possibility of error in determining the speed and altitude the absolute vertical and the consequent correct aim of the projectile. With the torpedo plane the chances of a miss are very small. The range may be as short as the nerve and skill of the aviator make possible. Moreover, the torpedo when it strikes, strikes below the water line, in the most vulnerable part of the ship. Again, the bomber must be, if not directly overhead, at least approximately overhead where he is exposed to anti-aircraft guns. He can be driven off by airplane guards also much more easily than the torpedo plane, because the latter can attack from any point of the compass and from any altitude; from positions as close to the water, for instance, that a fighting airplane cannot get under him, where he is the most vulnerable. Admiral Fiske has recently made an invention which he thinks will aid the torpedo plane very greatly, but its character is not yet known, except to a very few.

It is not the function of the stories in this series on great living inventors and scientists to engage in controversies, take sides, or enter into argument with the Governmental powers that be, regarding inventions and inventors But it was noted in these pages that the Lewis machine gun received its accolade in France and Flanders after America had rejected it; and it is stating only the facts to admit that America was offered the torpedo plane by its inventor, that institutes, associations, officers, scientists and manufacturers endorsed the idea and the invention to the Navy Department, only to have it rejected; and that at the time of the Armistice, Great Britain had perfected Admiral Fiske's original idea to the extent of having a great number of such torpedo planes ready for action, and that the surrendered German fleet was met and escorted to its disgraceful end by, among other things, a ship with torpedo planes aboard, which at the slightest hint of treachery would have proven once and for all that even mighty ships of steel cannot withstand torpedo attacks from the air.

It would be difficult if not impossible in a story of this length even to epitomize Admiral Fiske's inventions for the Navy which is so much his own work When a man lives in the Navy from boyhood to retirement, and when such a man is naturally an inventor and has in addition perfected himself in certain branches of science with the one idea of aiding the Navy, his contributions come too fast and in too many numbers adequately to catalog While his most important ideas have here briefly been set forth, it would be entirely wrong to fail to mention the great effect Admiral Fiske's work has had on the electrical equipment of fighting ships of all sorts and to chronicle that range finders, gun sights, direction finders, systems of fire control and a hundred other ideas regarding the actual aiming and firing of guns (the end and aim of a fighting ship) have come from him in great numbers An invention which he made in 1897 and on which he secured the basic patent in 1900, is now about to come into use This is his system of "Wireless Control of Moving Vehicles," which John Hays Hammond has done so much to develop, and which our navy has successfully used for directing the movements of battleships intended as targets

Admiral Fiske has often been prevented in the development of an original idea, either by the exigencies of the service or the press of work attendant on the perfecting of even more important inventions, and has seen original conceptions of his own taken up and perfected by others who thus received the credit, which he would be the last to say was not their due, for working out to the point of practicality, an idea of which he was the real originator. But Admiral Fiske has the undoubted satisfaction of knowing that more than sixty patents of his have done more than sixty much needed things for the Navy and that in spite of red tape, official discouragement and sometimes that open hostility to any change which pervades huge governmental machines, his work and labors have aided in making the United States battleship second to none, and that his labors, his patents, his devices and ideas have had much to do with making that ancient contention, that United States ships were but copies of ships of other navies, an outworn phrase heard now only in the mouths of the envious.

It is pleasant to find in Rear Admiral Fiske's book, "From Midshipman to Rear Admiral," a happy reference to this journal, and to learn that at one time, when

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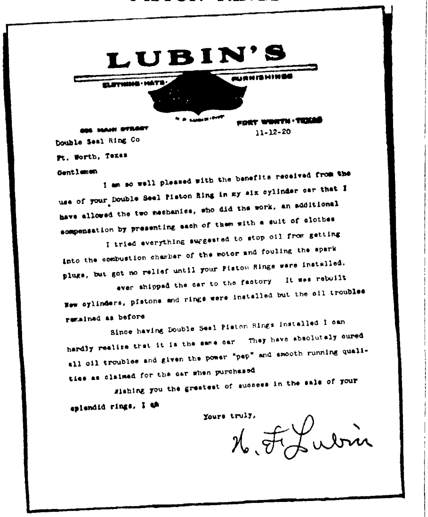

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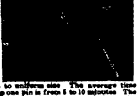

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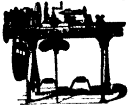

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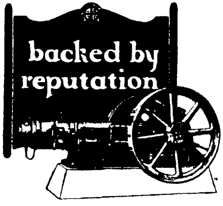

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discouragement had caused him seriously to consider dropping a naval career for one of possibly larger financial reward in business, he desired to go to work for the sheet which now devotes this space to sketching his inventive activities As an editor of the SCIENTIFIC AMERICAN, no one who knows him doubts that he would have carried forward the torch of scientific ideals which this paper has always striven to keep brightly lighted, but in the interest of our first line of defence it is surely a matter of congratulation that one of the most prolific inventors of modern times should have persevered in his chosen profession, rather than left it for the more quiet haven of an editorial office.

Insect Ravages in Our Forests

(*Continued from page 48*)

thereby saved more than $100,000

"The presence of the southern pine beetle in dangerous or destructive numbers is plainly indicated by patches of dying and dead pine which show no evidence of injury by fire or other destructive agencies," says the Bureau of Entomology in describing insect depredations in the South Observations in the Southern States are responsible for an authoritative statement that if all the pine killed for 20 years by the beetle was living today, its stumpage value would be appraised from $10,000,000 to $20,000,000. Studies of insect wrought havoc in the South Atlantic and Gulf States for a period of three years indicate that at least $2,000,000 worth of pine has been squandered by natural enemies of the forests Briefly stated, the method for arresting the invasion of the southern pine beetle is to locate the infested trees during November, December, January, February and March and destroy the overwintering broods in the bark of the main trunks This may be accomplished by a number of ways Remove and burn the infested barks from the trunks of standing trees or after they have been cut down, place the infested portions of the trunks in water or convert the trunks of the infested trees into cordwood and use the wood for fuel before the beetle leaves the bark

That insects are constantly menacing the lumber industry can be illustrated by examples of visitations other than those so destructive to Douglas fir or balsam and the southern pine The value of black or yellow locust has recently been accentuated as a derivative for locust pins or tree-nails in the construction of wooden ships Growth of the trees, other than scattering specimens in forests, farmers' woodlots and abandoned fields, has been futile as a commercial enterprise because of the depredations of the locust borer. The handicap under which commercial operations labored inspired a specialist in forest entomology to make an investigation, his conclusions being significant·

"It appears practically certain that plantations of this tree can be protected successfully from the borer and grown profitably on a commercial scale if the locusts are planted in thick stands or mixed with other trees so as to produce a densely shaded condition and natural pruning during the first ten to fifteen years of growth" The Pennsylvania Railroad planted 42 plantations, comprising 2,000 acres, embracing the culture of over 1,000,000 trees Some of these locust plantations are in prime condition while others have completely succumbed to the attacks of the locust borer Here are some reasons advanced by a Government investigator for immunity to insect attacks: For some inexplicable cause trunks of trees attaining to 5 inches in diameter and over rarely contain borers, sufficient shade during the period of growth is a deterrent to borer infestation, and once the pests have intrenched themselves in new growth an arsenical spray is a death-dealing application.

As previously stated, the depredations of insects are not so spectacular as a forest fire; nor are the earmarks of destructiveness so pronounced. Yet the evidence is convincing—a clump of yellow-top or red-top trees in the distance, closer scrutiny and you observe pitch tubes and boring dust on and around the trunks of living trees—the signals are unmistakable for action in forestalling widespread destruction Combating a forest fire is a hurry-up job; beetle control affords a leeway of from six to ten months in which to utilize or otherwise efface the affected timber in doing away with the broods of beetle in the bark The beetles of the genus Dendroctonus are identified in the adult stage by their cylindrical, somewhat elongate to stout bodies, broad and prominent heads, nearly round to oblong, oval and transversely placed eyes behind the base of each antenna. Among the Dendroctonus beetles there are isolated species which are attracted to weakened and dying trees and to the stumps, logs and tops of recently felled living trees Hence, the trap-tree method of control where trees are cut as a decoy for the insects to breed therein before their destruction

Among the requisites prescribed by the Bureau of Entomology in combating bark beetles are· Give prompt attention to evidence of an outbreak, as indicated by an overshadowing percentage of yellow or red topped dying trees, and especially when these signs occur in groups of ten trees or larger areas; obtain information as to the identity of the species creating the trouble, and adopt the most effective control method for destroying 75 per cent or more of the insects in the infested trees Here are some of the formulas of control: Utilize the infested timber and burn the slabs during the period in which the broods of the beetles are in the immature stages or before the developed broods emerge from the bark, or—fell the infested trees and remove the bark from the main trunk and burn the bark if necessary, remove the infested bark from the standing timber and burn the bark when necessary, immerse the unbarked logs in ponds, lakes or streams, where the bark will remain soaked long enough to kill the insects, or remove the unbarked logs or products to a locality where there are no trees liable to attack within a radius of 20 miles or more Continued scientific research, augmented by an arousal of public appreciation as to the importance of organized warfare on the tiny foes of the forests, should ultimately minimize the enormous forfeiture of $70,000,000 to the alarming depletion of the Nation's timber supply Any National forest policy which would strengthen the arms of the entomologist in protecting the forests from foes within is characterized by that same forehanded wisdom that builds a lookout station on the pinnacle of a mountain peak and details a guardian to safeguard Nature's bounties

The United States Light Cruiser "Omaha"

(*Continued from page 49*)

Navy, is the adoption of the British tripod mast, at the head of which is located a closed director-fire position, from which the fire of the battery of twelve six-inch guns will be controlled A secondary battery will consist of two three-inch, 50-caliber aircraft guns and two three-pounder saluting guns. The vessels will also carry two 21-inch twin torpedo tubes which will be located on either beam on the main deck between the aftermast funnel and the main fast. The boats will be liberally supplied with searchlights and range finders.

Altogether these vessels should prove to be very serviceable craft. The pity of it is that they are not in commission today. The only representatives of the light cruiser or scout class which we possess at present are those relatively slow and out-of-date scouts the "Birmingham," "Chester" and "Salem," the keels of which were laid fifteen years ago.

Truck-Weight Legislation

(*Continued from page 54*)

the big engines have 16 driving-wheels; the early engines had only four.

It would have been as sensible fifty years ago to have prohibited the use of locomotives larger than the little four-wheeled drivers, as it would be today to limit the weight of the motor truck on any other basis than tire width, and the number of wheels under the weight, which in the case of our large locomotives gives several hundred per cent greater hauling capacity with probably only one hundred per cent greater weight of rail. Without the development of the large locomotive and the increased size of railroad cars, freight rates would probably be double or triple what they are now and they seem plenty high enough at the present time to those who pay them. If we set an artificial limit on motor-truck weight we are handicapping what is fast becoming an important means of transportation, adding to the cost of every article of food or clothing we use, and placing a generally greater economic burden on the country. We must build the roads to carry the loads, not limit progress by using highways of inadequate construction when better and more resistant paving should be provided to keep pace with the more efficient forms of motor transports.

The Short Haul Problem

(*Continued from page 54*)

as to their terminal and short-haul costs. From the best figures obtainable it seems that their terminal charges amount to about 10 cents per 100 pounds at each end of the line. Terminal charges include the switching and placing of the car, loading and unloading, the clerical work necessary to take care of this work, and general overhead charges to be proportioned to these operations. An authority has said that it costs about $35 to deliver a car in Manhattan or Brooklyn after it reaches the Jersey Terminal, while in Chicago it costs something like $10 35 and in a small city like Binghamton, N Y, $1.80 Against the 20-cent terminal charges the average cost of the line haul is less than one cent. The big charges are for loading, unloading and handling, and unless a shipment goes a sufficient distance to warrant all this labor, the practice is not economical.

Fifteen cents per hundredweight is a fair charge for cartage at each end of the line when considering less-than-carload shipments Adding to this the terminal charges mentioned, we find that the transportation cost of this shipment, exclusive of the cost of the line haul, from door to door is 50 cents. From this it is reasonable to infer that for any locality to which the motor truck can deliver for 50 cents per 100 pounds or less it would be more economical to ship by motor truck This does not take into consideration the service meaning of a delivery in a few hours which on the railroad might take two weeks

It would seem reasonable to suppose that on all distances under 50 miles the railroad is losing money. Rather than tax the long haul to make up for short-haul loss, it would seem more practical to do away with the business which is carried at a loss. The thousands of cars, containing package freight, which come into stations to be broken up and redistributed to other roads, block the entire traffic stream and tie up through freight because an arrangement has not been made to transfer these small-lot shipments immediately by vehicles from the incoming cars to the railroad that is to carry them out. This delay holds up thousands of cars every week.

The answer to this problem is to increase the use of motor trucks for all short haul work and thus release many freight cars that are now working to less than half capacity for the work they can do to the best advantage.

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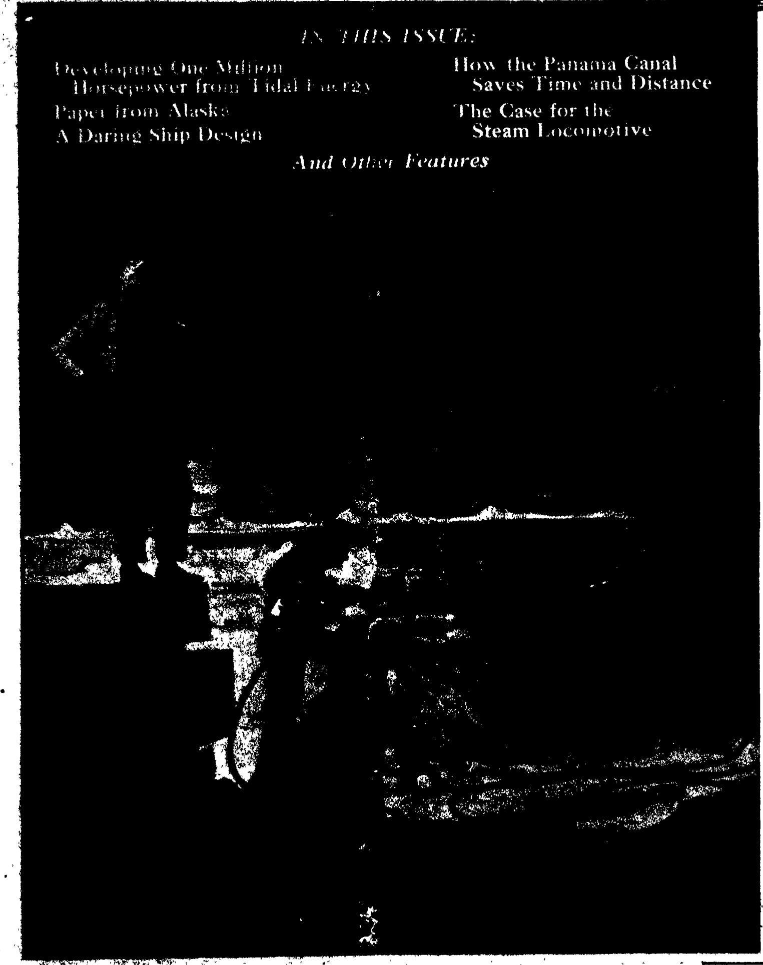

IN THIS ISSUE:

Developing One Million Horsepower from Tidal Energy

Paper from Alaska

A Daring Ship Design

How the Panama Canal Saves Time and Distance

The Case for the Steam Locomotive

And Other Features

CLEANING A HUGE MOTOR FRAME CASTING AFTER IT HAS COOLED.—[See page 69]

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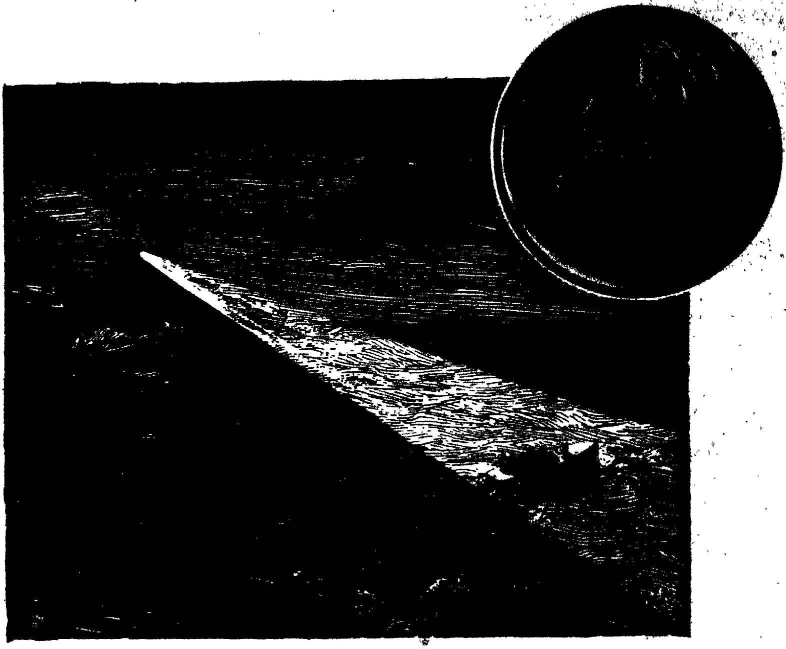

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Smugglers, and those who prefer their activities concealed, find safety in this all-pervading blackness. Yet, to uphold the majesty of the law, these lanes of darkness must be policed.

Suddenly a brilliant beam circles the horizon. Quick as a flash it casts a penetrating ribbon of light—anywhere!

Wonderfully wrought lens-mirrors gather and project the brilliant light from powerful lamps—light that would be wastefully scattered without the help of these lens-mirrors.

Though little known, this activity of this institution, is of equal importance and compares in service with our other products—lenses for photography and projection, microscopes, binoculars, lenses for army, navy and engineering use, and most important of all, to humanity—spectacle lenses—for all are made that eyes may see better and farther.

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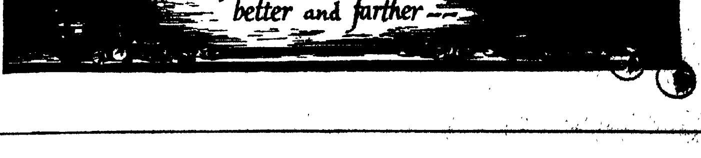

SEVENTY-SEVENTH YEAR

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Scheme, drawn up by the Engineers of the British Ministry of Transport, for developing 500,000 horsepower from the 30-foot tide in the estuary of the River Severn—[See page 67]

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The object of this journal is to record accurately and lucidly the latest scientific mechanical and industrial news of the day As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs

Labor and the Industrial Engineer

THOSE of us who were in close touch with the industrial situation twenty-five years ago will realize as they read Mr Gompers' letter on the facing page that we have reached a notable milestone in the progress of industrial relationship

Twenty-five years ago we knew little, if anything, of the industrial engineer in the present special meaning of that term In those days the age-long prejudice of labor against labor saving machinery was still encumbering the wheels of progress, although the more intelligent workmen were beginning to understand that the labor-saving machine, so far from being an enemy, was a friend In the intervening period, however the hard logic of facts has driven home to the great mass of labor the fundamental truth that, although the introduction of labor saving machinery may cause a temporary reduction in the working force it ultimately enlarges the demand for labor by increasing production, reducing the cost, and multiplying the public demand for the finished product No workman, however humble his position or however simple his processes of thought, can fail to contemplate such a modern industry, let us say, as the Ford plant, with its 50 000 workmen, its output of 3,000 machines per day and its minimum daily pay of six dollars, without realizing that the automatic machine and the traveling work table are his very best friends

While this lesson was being taught there appeared in industry a specialized type of engineer who directed his attention not so much to the machine as to the man himself, with a view to simplifying and expediting his work by cutting out unnecessary movements and enabling him to do more work with the same total expenditure of effort But the industrial engineer, when he applied his attention and skill in this particular direction, was met with something of the same prejudice on the part of labor as was shown years before, at the first introduction of automatic machinery But with the passage of time there came a better understanding on the part of labor and a modification of his plans on the part of the industrial engineer, with the result that the value of his work is so fully recognized that Mr Gompers can say "A change in the conclusions of a great many industrial engineers, scientists of industry, is making it possible now for labor to welcome cooperation with them, and for labor *to do its full share in developing that cooperation*"

Finally, there is the question of the cooperation of the employer, without whose understanding and sympathy no progress is possible Fortunately the great majority of the employers are alive to the vital importance of the question of industrial relationship This is particularly true in that great industrial center known as the Middle West where various schemes, differing in details of application but similar in recognition of certain fundamental principles, are in successful operation Several of these have been published in our columns in a series entitled "Solving the Labor Problem" An outstanding feature in each of these systems has been the thorough coöperation of the employer who in every case has been sympathetic and in most cases has been the leading spirit in the movement

Science and the "scientific mind," as Mr Gompers calls it are no longer regarded as the friend of the employer *and the foe of labor*. That misconception has been buried under an accumulation of facts and experiences which have proved that it is equally the friend of both Increasing production and decreasing costs are bringing an ever-larger demand for intelligent and well-paid labor

Crippling American Aviation

WE recently took occasion to congratulate the Post Office Department on the extension of its Air Mail Service, and we were glad to note that the Postmaster General had asked Congress for an appropriation sufficient to insure the unhampered operation of the new aerial postal routes during the coming year Unfortunately for the future of this service, Congress has refused to provide the full sum required, and in fact has made a drastic cut Well *may Otto Praeger, Second Assistant Postmaster General*, predict that this ill-placed economy will be "a death blow to peace-time development of aviation!"

Just now the Air Mail Service is the mainstay of aviation in the United States It is the only service which has Government backing, and it is the only service which is of sufficient size to call for a steady supply of airplanes to carry on Unless Congress provides the necessary funds, some of the air routes must be abandoned with a corresponding loss of orders to the few remaining firms which are struggling to keep their plants in operation

We may just as well look the facts in the face, and acknowledge that the airplane industry is in a pretty bad way Several of the leading industries are in the hands of the receivers and if the Government pursues its policy of retrenchment, Heaven alone knows *where the few remaining firms are to look for support*

We are well aware that the present is a time for all-round retrenchment but these economies should be carried out with discretion Retrenchment should be made, first, in naval and military departments and not in those which have to do with peacetime civil utilities If Congress is wise, it will give to the Aerial Mail Service the very modest sum that it asks, and balance the account by an equivalent cut where it will not be so deeply felt.

If the Air Mail Service were still in the purely experimental stage, if its aircraft were unable either to deliver the amount of mail predicted or make the saving of time which should be its chief recommendation, or if it had proved too much subject to the vagaries of wind and weather to render it an efficient system for the carriage of mail, the refusal of the funds requested would be *more understandable*. But, as a matter of fact the mails have been carried regularly, expeditiously, and in great numbers, and these advantages have been gained at a cost which compares favorably, and in many cases more than favorably, with that of the regular train service Judged by its record, this new venture should receive most generous consideration for not only has the Post Office Department operated its mail lines over a distance that averages more than 6,000 miles every day, but it has extended its service from the Atlantic to the Pacific, and, during the past twelve months, it has carried over one hundred million letters

The So-Called Armament Race

IT is a strange anomaly that though there is just now a world-wide discussion of the so-called race in *armaments*, such a competition does not in fact exist On the other hand, if the present talk by the Secretary of the Navy and his immediate advisors about the necessity for us to build the biggest navy in the world is carried on much longer, the armament race will begin in good earnest It cannot too frequently be impressed upon the American people *that*, as the naval situation stands today, there is no other country which has a large program of construction in hand Japan, it is true, drew up a program for new battleships and battle cruisers, prompted, so her statesmen tell us, by the declaration of our Naval Secretary that, if the nations of the world would not join the League of Nations in the form in which the present administration had drawn it up, he would be in favor not only of completing our present large program but of doubling it—a policy which would call for the expenditure of another billion dollars of the taxpayers' money to see it through. The new Japanese *proposal is purely* on paper and apparently, so far as anyone can ascertain, no appropriations have been made to carry it on. There is certainly no race in naval armaments that can be called such so far as active Japanese building operations are concerned.

With regard to Great Britain, it is sufficient to say that in the face of Mr. Daniels' threat, she deliberately scrapped all of her pre-dreadnaught battleships, broke up three sister ships to the "Hood," vessels of 42,000 tons which were already in course of construction, and made a sweeping clean-up of *armored cruisers*, protected cruisers, destroyers and submarines that were not of thoroughly modern construction. Furthermore, she reduced her personnel from some 450,000 men to about 100,000, which is over 80,000 less than the present enlisted strength of our own Navy And for two years past, in spite of the, shall we say, militaristic attitude of our formerly pacifistic Secretary, she has drawn up no program whatsoever for future new construction Evidently, there is no race in naval armaments between the United States and Great Britain.

Nevertheless, in spite of the mortification with which the great body of the American people have witnessed this ill-timed and uncalled-for "swash-buckling," it has not been without its good effects It has served to call forth, mainly through the efforts of one of our great leading dailies, a widespread protest against the continuation of huge appropriations for naval and military construction, which has been surprising in its world-wide range and unanimity of sentiment. Both here and abroad, statesmen of all shades of political opinion, naval and military officers of the highest rank, leaders of thought in the church, at the bar, in education, and in literature, have responded in no unmeasured terms of approval to the suggestion, that the nations of the world should get together in an endeavor to reduce their existing naval and military *programs and cut down future* appropriations to the requirements of post-war conditions

Among the very few dissenting opinions are those of a few men who fear that the present agitation may throw this country back into the condition of unpreparedness with which it was confronted at the beginning of the late war The SCIENTIFIC AMERICAN does not believe that there is ground for any such anxiety Not during this generation at least will the American people forget the lesson of that feverish period, when we *endeavored to do in one* year what could have been so much more cheaply and better done in the previous ten years. When they are engaged in the pastime of filling in their annual tax papers and enclosing the accompanying check, they will have a periodical and very poignant reminder of the costliness of unpreparedness Nobody, of course, who is qualified to speak on the subject of disarmament would wish to see the wholesale scrapping of our fleets, razing of our forts, and destruction of our accumulated artillery What is needed and what we believe will come is a great reduction of present shipbuilding and a mutually agreed upon adjustment of the relative strength of armies and navies to the several needs of the nations concerned.

So far as the great peoples which fought together for the principles of justice and humanity are concerned, this adjustment should present no insuperable difficulties Such unrest and mutual distrust as seems to have developed among the Allies since the armistice has been altogether artificial in its origin It is the result of an insidious propaganda, largely racial in its origin, which has been deliberately designed to break up that unity of feeling between us and our Allies, and particularly between the United States and Great Britain, which was, and ever will remain, the greatest asset of the late war.

The *slogan of this* propaganda is the phrase, "Freedom of the Seas," which had its origin centuries ago, and was resurrected by Germany when she began to feel the pinch of the blockade. It was aimed, of course, against the British fleet, which, thank Heaven, was strong enough to preserve the freedom of the seas, for herself and her Allies to move their armies when and where they would For all law-abiding and peaceful merchant ships the seas have been "free" for a hundred years past

Electricity

Electric Incubator.—An ingenious inventor of Racine, Wis., has recently introduced an electric incubator especially designed for city and suburban poultry raisers. It has a capacity of seventy-five eggs and is heated by means of two electric light globes placed in the top compartment. Between these globes and the lower egg chamber is a steel plate which retains and distributes the heat. A thermostat regulates the heat and keeps it at 103 deg. all the time.

Better Telephony.—From France comes a new idea in the way of better telephony, consisting in amplifying the telephone currents immediately upon their leaving the microphone transmitter to such an amplitude that the power-line disturbances become relatively insignificant. A vacuum-tube amplifier is used in each end of the line. The signals are reduced to normal strength at the receiving end by connecting high resistance in series with the receiver or by using a non-inductive shunt. It is claimed that satisfactory protection may be obtained by this French system, even when the telephone line runs along a single-phase railroad without balancing return feeder, or when it is carried on the same poles as a high-tension transmission line.

The Golpa Super-Power Station.—The steam generating plant at Golpa, Germany, from the beginning was intended to provide the nitrogen-fixation plants at Piesteritz with 500,000,000 kw-hr of electrical energy a year and also to supply a large nitric-acid plant in the neighborhood with about half of this amount, according to *Electrical World* The generating plant is located close to a lignite mine, the cable cars take the coal directly from the mine to the stokers. The daily consumption is 6,000 tons. There are sixty-four steam boilers, feeding eight turbines, each coupled to one 22,000 kva generator of 6,000 volts and 50 cycles. After the shutdown of the war-time nitric acid plant the output from part of the units was taken over by the city of Berlin, the power being transmitted over a 78-mile, 110,000-volt line

Alternating - Current Mercury - Vapor Lamp.—A new form of high-voltage alternating current mercury-vapor lamp developed by Henri Georges of France is described in a recent issue of the *Revue Generale de l'Electricité* In ordinary circumstances it is only possible to run such lamps on an alternating supply by the use of special electrodes. M Georges, however, overcomes the difficulty by introducing neon gas into the tube, which is of quartz The present lamp takes one ampere at 2,250 volts, but it is hoped to construct lamps taking up to 10 kw and furnishing the most powerful source of ultra-violet energy known.

The National Research Council has entered into an extensive campaign to investigate the principles of insulation, a matter of vital importance to the electrical trade and to its consumers, we learn from *Electrical Review*. A meeting of the council's insulation committee was held recently in New York City, F B. Jewett, chairman of the committee, presiding. For some time past the National Research Council has been endeavoring to formulate a practical plan whereby coöperation between the universities, the industries and the National Research Council might be accomplished in attacking the problems involved in fundamental research upon insulating materials.

A Five-thousand Foot Span, so far as is known the longest span in the world, is on the Knoxville Power Company's transmission line. The horizontal distance between supports is 5,010 feet. The difference in elevation is 208.5 feet. The conductors are 500,000-circular mill steel-cored aluminum cables which are under a tension of 19,000 to 20,000 pounds at 80 deg. F. Operation is at 150,000 volts

Transatlantic Radio Telephony with 100 Watts appears to have been achieved by Hugh Robinson, a radio amateur of Keyport, N J. Some time ago Mr. Robinson, while operating his radio telephone and transmitting phonographic music, was heard in Aberdeenshire, Scotland, or over a distance of 3,500 miles. It seems almost unbelievable that a radio telephone set operating on 100 watts should be heard over a distance of 3,500 miles, yet that is what the evidence in this instance would indicate.

Statement for the SCIENTIFIC AMERICAN by Samuel Gompers, President of the American Federation of Labor

An inquiry from the Managing Editor of the "SCIENTIFIC AMERICAN" for an elaboration of recent statements to the effect that labor proposed a new relationship between itself and scientists calls first of all for a proper stating of the basis for inquiry.

The situation is not that labor is just now opening its mind to something which it had previously refused to consider. A better statement of the situation is to say that a change in the conclusions of a great many industrial engineers, the scientists of industry, is making it possible now for labor to welcome co-operation with them and for labor to do its full share in developing that co-operation

The organized workers fully understand that industrial processes can be materially improved, that the relation between workers and employers can be improved and that the human element in production can be made freer and more efficient by the establishment of proper co-operation between labor and the industrial engineer.

Of course, the co-operation of the employer also is necessary, since the position of the employer in industry is such as to make it impossible to make much progress if he chooses to stand in the road, unseeing and unbending.

It would be improper and unreasonable to say that great changes in industry are to be brought about quickly through co-operation with scientific minds in industry. It is proper and accurate to say that labor in its organized capacity is seeking to bring out the full value of the scientific mind and that it hopes through a better relationship with engineers to make possible marked improvement in the industrial life of the nation, ethically and materially.

Washington, D. C.,
December 23, 1920.

Sam Gompers

Science

The Oceanographic Section of the International Union of Geodesy and Geophysics has been summoned by the Prince of Monaco to meet in Paris January 25, 1921.

The Cactaceae.—The second of the four volumes of the great work on the *Cactaceæ* by N L Britton and J. N Rose, has been published by the Carnegie Institution of Washington

A Polar Research Institute is to be established at the University of Cambridge, England Funds for providing quarters, as an annex of the new School of Geography, have been given by the Captain Scott Memorial Polar Research Trust The institute, says *Nature*, is to act as a center both for information on polar matters and for the working up of results, and is to include a polar library of bibliological and geological specimens, and rooms for carrying on research

The Action of Nitrogen Upon Platinum in the Presence of Nickel has recently been studied by Mr. F. Wolfers of Lausanne In his report read before the Swiss Society of Physics he states that nickel is attacked by nitrogen at a temperature of about 300° C in the absence of oxygen, forming a volatile nitride, which becomes unstable at 600° C, and that this nitride violently attacks platinum, causing it to become crystalline in structure and brittle Consequently, it is inadvisable to employ thermo-electric couples of platinum in an atmosphere of nitrogen in the presence of nickel, at a temperature of more than 500° C

Geographic Data for the United States, recently published by the Geological Survey, show that the gross area of the country is 3,026,789 square miles, including 53,015 square miles of water surface comprised in the Great Lakes, and the oceanic waters of the country within the three-mile limit The southernmost point of the mainland is Cape Sable, Fla, which is 49 miles farther south than the southernmost point in Texas The northernmost point is in Minnesota, the easternmost point is West Quoddy Head, near Eastport, Me, and the westernmost point is Cape Alva, Wash From West Quoddy Head due west to the Pacific Ocean the country is 2,807 miles wide, while the shortest distance between the Atlantic and Pacific is 1,152 miles, between points near Charleston, S. C., and San Diego, Calif The curved parallels and meridians of the ordinary map projections are responsible for widespread erroneous ideas as to relative latitudes and longitudes of places Thus, few people realize that the island of Cuba, if transported due north would extend from New York City to Indiana, or that Habana is farther west than Cleveland, or that the Panama Canal is due south of Pittsburgh, or —perhaps most surprising of all—that Nome, Alaska, is farther west than Hawaii.

Aeronautics

Credit to Whom Credit Is Due.—Quite inadvertently we overlooked giving credit to Vickers, Limited, of Great Britain, in the article entitled "Building a Rigid Airship," which appeared in our issue of January 15th. Vickers have built several large rigid dirigibles and have quite equaled the German builders of airships, despite the fact that the latter have been doing this highly specialized form of work for many years.

Aviation School for Ecuador.—The Ecuadorian Congress during a recent session passed a law providing for the establishment of a school of aviation in Guayaquil and in Quito The services of foreign experts are to be solicited, and funds are to be raised and appropriated for the maintenance of these schools The public has contributed a large sum toward the purchase of airplanes, and one has already arrived at Quito.

The Navy's Planes for the Public.—To encourage the development of commercial aerial transportation and the training of civilians as airplane pilots for use in time of war, the Navy Department has authorized the sale of 125 coast patrol flying boats at about one-third cost price The machines are of the "H S 2-L" type, equipped with 400-horsepower Liberty motors capable of seating six persons The planes are well adapted to mail, passenger and express service, forest patrol, timber scouting, surveying and pleasure purposes, according to Naval officials

Expenses of Aerial Service.—In the course of a statement in the French Chamber recently, the Assistant Secretary of Aviation stated that the cost of upkeep of airdromes, hangars, repair shops, meteorological and wireless stations on the French portion of the Paris-London service was estimated at 20,000 francs per kilometer as against the cost of 50,000 francs per kilometer for a single line of railway He thought that in the future the total cost of organizing an aerial service would be 10,000 francs per kilometer On the other hand, he emphasized the difficulties due to present heavy charges on flying plant, the French calculation of the life of an airplane being 200 flying hours, which meant that about 3 50 francs per kilometer had to be added to the total cost of the service This, however, he had hopes of seeing reduced

The Caproni Giant.—From a recent issue of *La Gazzetta dell' Aviazione* we learn the following facts regarding the new giant "Caproni" The boat is built of three-ply, internally braced on the lines of the system used for railway carriages, and the three sets of planes are some 40 meters span with elevator ailerons, no other longitudinal control surfaces being employed The eight Liberty 400-horsepower motors are mounted in tandem, four on the foremost and four on the rear triplane, in power eggs connected by two dummy fuselages Control is by wheel with patent ball-bearings throughout, and is expected to relieve the single pilot from undue strain Electric light signaling for conveying orders to the engineers has been adopted and the machine has been designed to fly on four engines only Ninety-eight passengers are to be seated in the hull

Wright Patents in France.—The French aviation industry seems to have its fair share of troubles, states *Flight* Now that the "joy stick" litigation is settled, at any rate for the moment, the owners of the French Wright Patents have secured from the courts a writ of attachment on some 3,000,000 francs owing by the Minister of Finance to one of the French constructors The writ has since been modified as regards 800,000 francs of the total which the firm requires immediately for development purposes

High Altitudes and the Human Organs.—A peculiar account is given of two theories to account for flying sickness and of the experiments on which these theories are based The French school, headed by Professors Bert and Regnard, holds that it is caused by shortage of oxygen, while the Italian school, led by Professor Mosso, maintains that shortage of oxygen does not of itself account for the sickness, but that collapse is due to lack of carbonic acid in the blood at high altitudes Up to 9,000 meters, application of oxygen will overcome the sickness, but above that height a mixture containing carbon dioxide and oxygen is necessary.

Paper from Alaska

The Prospects of a Permanent Supply of Pulpwood from Our Arctic Establishments

By James Anderson

MUCH has been said, some of it in these columns, about the paper shortage. Obviously the situation is one which can be met only by an expanded supply or a contracted consumption. We do not find it convenient to contract our consumption and we are not at all confident that continental United States will be able to enlarge its production of pulp. There is, however, one factor of hope which is more often than not overlooked. The present article in our series on pulpwood and timber in general aims to show the place which Alaska may come to fill in our paper industry.—THE EDITOR.

THE eyes of news print users in all sections of the United States are now focused upon Alaska. To her, it now seems probable, will in the near future be assigned the task of solving one of the most acute problems of the present day—that of the paper shortage. Uncle Sam's forestry experts agree that in only one way can the shortage of news print be overcome and that is by the establishment of huge paper mills in Alaska. For the National Forests of Alaska contain resources sufficient to produce 1,500,000 tons of paper annually in perpetuity, and a huge paper industry in the territory is a certainty of the future.

Already a sale of 100,000,000 feet of pulp timber has been made, and a second sale of 1,500,000,000 feet, which will supply a great paper plant for more than thirty years, is now being arranged. The National Forests of Alaska offer paper manufacturers an ample supply of pulp paper at low prices and subject to very reasonable and simple cutting requirements. The Forest Service is doing its utmost to develop this resource of the territory. It expects not only to make Alaska one of the great sources of paper for the United States but to make the industry permanent as it is in Norway. Paper manufacturers who go to Alaska can count upon an assured supply of raw material indefinitely.

Spirit Mountain and Copper River, in the heart of Alaska's lumber country

The timber depletion in the United States within the past few years with the resultant depletion in news print paper has been one of vital concern not only to publishers but to the entire populace of this country. Three fifths of the timber originally in the United States is gone. The forests of the country are estimated at one time to have covered 822 million acres and to have contained 5,200 billion board feet of timber. Over two thirds of this area has already been culled, cut over or burned. There are left today only about 127 million acres of virgin timber, 112 million acres of culled and second growth timber large enough for sawing and 133 millions partially stocked with smaller trees of secondary growth.

Every year the United States is taking about twenty-six billion cubic feet of material out of its forests and growing about six billion feet in them. The result is that every year far more timber is cut than is grown. Even trees too small for the sawmill but upon which our future lumber supply depends are being used up today by the paper manufacturer three and one-half times as fast as they are being produced. The inevitable result of this is that lumber and pulpwood prices have risen to unprecedented limits. In March of last year average mill prices in the South and West had advanced three hundred per cent over those of 1914. The average advance on high grade hardwoods in eastern wholesale markets was from two hundred to two hundred and fifty per cent and even at these levels the demand was unsatisfied. Prices, indeed, were so excessive in the spring of last year that buying was to a very great extent automatically checked.

The resultant shortage of news print has been such that many of those publications which did not suspend operations have been forced to triple the price of their product. The lumber shortage and high prices have seriously affected almost the entire population in still another way. It has checked building operations and the development of agricultural lands and needed improvements on farms. Besides many industries have been unable to secure their supplies of timber at any price.

A Sitka spruce forest in Southern Alaska

In view of these facts it is small wonder that attention now turns upon Alaska to relieve the situation, with its enormous forests of rapidly growing trees suitable for pulp. A substantial development of the paper industry in this region, combined with the intelligent reforestation of pulp lands in the older regions, should settle the question of a paper shortage in the United States.

The National Forests of Alaska probably contain 100,000,000 cords of timber suitable for the manufacture of news print and other grades of paper. Under careful management it has been estimated that these forests can produce 2,000,000 cords of pulpwood annually for all time, or enough to manufacture at least one-third of the pulp products now consumed in the United States. It is easy to imagine what a tremendous help this would be.

The Alaskan forests also contain the second chief essential of a paper-manufacturing industry—water-power. While no accurate survey of this has been made, known projects have a possible development of over 100,000 horsepower; and it is estimated that a complete exploration of the National Forests in southern Alaska will increase their potential power to a quarter of a million.

At present western hemlock and spruce are the standard pulpwoods for the United States mills in the Pacific Northwest, the hemlock being consumed in greater amounts than any other single species. In 1918, 145,583 cords of hemlock pulpwood and 35,385 cords of spruce were consumed in Washington, Oregon and California.

Both of these trees are widely and thickly distributed about the Tongass region in Alaska. Western hemlock occupies about sixty per cent of the merchantable stand and is also being extensively used for pulp at a number of plants in British Columbia. Spruce forms about twenty per cent of the stand, and varies greatly in percentage of mixture, from pure stands of ten acres or less to stands in which it is practically absent. From these two woods the following papers are made: Manila, cartridge, sheathing, book, label, writing, and related papers. These facts show that the two principal species of Alaska timber are both commercially suitable for mechanical and sulfite pulps, and the papers that are usually made from them.

Not a stick of timber for commercial pulpwood has as yet been cut in Alaska. The 400,000,000 feet of timber sold and cut to date from the National Forests in Alaska has been made into products such as piling, sawlogs, and shingle bolts. The logging methods have been developed from "hand logging," in which the trees were felled so that they would fall directly into the water or could be rolled in by hand, to steam donkey logging, the donkey being mounted on a raft and "beached" at high tide, yarding directly into the water. Later two donkeys have been used, a yarder and a roader. In the water the logs are boomed and towed to the sawmills.

The logging heretofore has been of comparatively large or selected timber. Pulpwood cuts will have larger yield per acre, as smaller timber will be cut. It is doubtful if the present system of logging is the best and cheapest that can be devised for pulpwood logging on an extensive scale. An overhead system seems to promise one solution of the problem. In this system a number of small logs could be brought to the water with a "choker." Gravity chutes might be profitably employed on the steeper slopes. For material further back it might be necessary to put in logging railroads. No two logging units, however, would present the same

(Continued on page 75)

Group of pulp-timber trees in Nakat Inlet

Every Automobile Its Own Elevator

By Robert G. Skerrett

ONE of America's biggest problems is to eliminate lost motion in every phase of transportation—using that term in its widest sense. It costs money to move anything any distance, for the work involves an expenditure of time and effort. Whenever commodities are shifted from one conveying medium to another there is a break that halts for the nonce the steady flow of the goods. Trite as these facts are, and well known by every traffic expert, it is doubtful if the average citizen realizes how much more he has to pay in the long run because of the interruptions in the transportational tide

The automotive vehicle is doing much to bridge the gap between terminal facilities; it is speeding up the transfer of merchandise where formerly the service limped, but the great majority of owners of cars and trucks have not yet awakened to the full potentialities of these vehicles as carriers In industrial and business circles, for instance, it has occurred to comparatively few that it is entirely practicable to utilize the hill-climbing powers of the truck and car to link directly the floors of shops, factories, warehouses, garages, etc., with the public highways, and thus to avoid dependence upon the elevator as an intermediate agency.

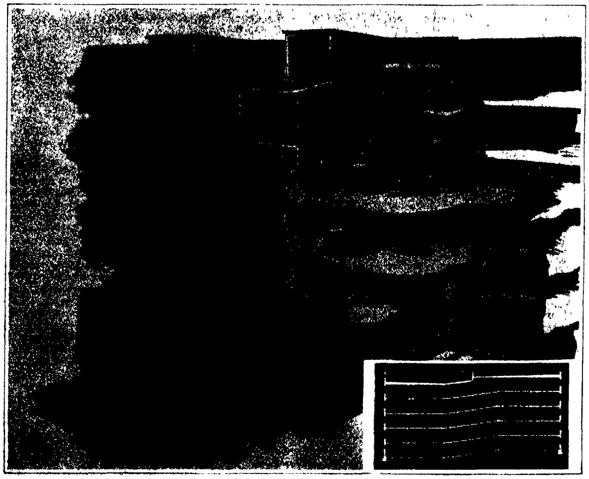
Take the general run of department stores, manufacturing establishments, and bustling warehouses, and what is the usual procedure in getting wares, products, and freight broadly in and out of the buildings? Well-nigh invariably, inter-floor movement is effected by means of more or less capacious elevators These lifts use a platform on the ground level as the link between themselves and the delivery wagons and trucks that bring in or take away the various commodities involved The mind instinctively pictures the series of handlings necessary to deal either with outbound or arriving goods

Without any intention to underestimate the elevator, it should be plain that much might be saved if every story could, in effect, be just as accessible to the motor vehicle as the ground floor, and this without the help of the freight lift Why not make it practicable for trucks and delivery cars to climb directly to any floor of a business or industrial establishment, there to load or unload as the case may be? This can be done.

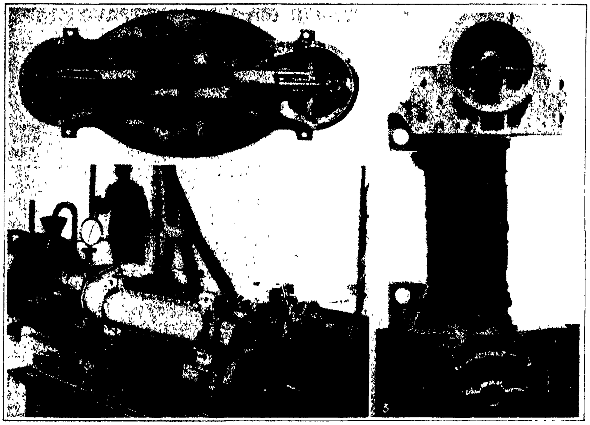
Of course, many of us are familiar with those inclined extensions of the street, commonly termed ramps, which make it possible for motor vehicles to get in and out of the basements or to reach one or more of the floors of a structure above the ground level. This means of ingress and egress has been adopted for a goodly number of garages, and has served to obviate the installation of elevators. While a step in the right direction, these ramps have compelled sacrifices in revenue-making space that have minimized the economies promised by the abandonment of the lift Let us make this clear

Where the inter-floor space has an average height of 12 feet, for instance the gradient of the ramp must not be too steep to make it easy and safe for the motor car or truck to climb or to descend from floor to floor Accordingly, an ordinary ramp, with its end turns, calls for a linear span of approximately 140 feet, of which at least half is required for the ramp alone Where the ramps are carried to succeed-

(*Continued on page 75*)



Sectional views of two garages with staggered floors, equipped with a central motor ramp in place of an elevator. The larger seems practical also for heavy inter-floor movements in warehouses, etc.



1 Section through the engine The pistons move in and out together The intake ports are seen at the right and the exhaust ports at the left The big openings above and below the former are the passages which deliver air from the blower to the intake ports The spark plug is above the combustion chamber, with the fuel injection pipe directly beneath it. 2. The engine on the test stand The cranking mechanism, water pump and magnetos are seen at the right end, the peculiar stick-up pipe is the exhaust 3 The engine partly assembled showing cylinders and upper half of crankcase

Junker engine of modified Diesel type for airplane use

A Near-Diesel Engine for the Airplane

By Harold F. Blanchard

NOTHING could be more interesting to those familiar with internal combustion problems, than the news that the Diesel engine has been successfully applied to airplane practice The new engine has been installed in a German monoplane and was designed by Professor Junkers The advantages claimed are those of low weight per horse power, increased reliability, higher fuel economy, greater simplicity, safety against fire, and perfect balance

In order to appreciate fully the features of this engine it is necessary to explain the Diesel engine principle In the true Diesel neither carburetor nor ignition is employed The compression is extremely high Instead of employing a maximum compression pressure of 80 to 100 pounds as in the ordinary designs with which we are familiar, compressions as high as 600 or 700 pounds are employed The extreme compression raises the air to a very high temperature so that when a carefully measured quantity of fuel is injected into the cylinder at just the right moment the air is so hot that the fuel immediately takes fire "Throttling" of the engine is obtained by varying the quantity of fuel delivered The injection of the fuel by the way, occurs in the instant just before the piston reaches top dead center The fuel is immediately vaporized by the excessively hot air and is thoroughly distributed throughout the combustion chamber almost instantly From this consideration of the subject it is plain that the Diesel engine is a type in which the compression pressure is constant whereas in the ordinary type used in airplane work the compression pressure is varied according to the demand by opening and closing the throttle

When Diesel engines were first produced they attracted considerable attention because of their unusual economy no type of prime mover has yet been devised that approaches the true Diesel here This economy is due to the fact that a constant compression cycle is more efficient than a variable compression cycle, and also because efficiency increases with the compression pressure which is very much higher in the Diesel than in other types

The Diesel was long considered out of the question for use in automobiles or airplanes because of its extreme weight It was necessary to make the cylinder very heavy because of the high pressures generated in it and the reciprocating parts had to be strong to stand the high acceleration forces developed

The Junkers Diesel engine is a modification of the true Diesel in that high but not extreme compression pressures are used (about 210 pounds) and because of this reduction in pressure jump spark ignition is used to ignite the charge It is a six-cylinder two cycle, with

(*Continued on page 79*)

The Case for the Steam Locomotive

Improved Efficiency a Possible Alternative to Railroad Electrification

By Charles Frederick Carter

IT seems to be generally accepted today that the age of the steam locomotive is drawing near its close, and that the immediate future will witness electrification on a scale that can only be characterized as general We suppose that no partisan of the steam engine will deny that there are places where the conditions of traffic, grades and water supply combine to make electric railroading cheaper than the use of steam But Mr. Carter calls our attention to the fact that in the general case, apart from any such extraordinary circumstances as dictated the St Paul electrification and the use of current in the suburban territory adjacent to our large cities, a very good brief may be put in for the steam locomotive. We are glad to give him the space in which to develop this brief, and to tell why he does not believe that electrification on a nation-wide scale is either imminent or necessary or even advisable —THE EDITOR.

HAS the steam locomotive reached the limit of economic development? Is it about to be superseded by electricity?

Taking the last question first because it is the more easily disposed of, the fact must be borne in mind that electrification of the railroads would involve the building of immense power plants, transmission lines, conductors, shops, machinery and locomotives—practically the rebuilding of existing facilities Statistics compiled by the Bureau of Railway Economics show that in the fourteen years from 1921 to 1934, inclusive, debts aggregating more than ten billion dollars will fall due and must either be paid by the railroads or refunded As the railroads are prohibited by law from earning returns equal to those yielded by other forms of investment, refunding is not likely to be simple or easy If it is going to be difficult to meet outstanding obligations, how are the railroads to raise the enormous sums which would be required for electrification of even the principal lines, superadded to financial requirements for other and urgent improvements?

Fortunately for the country railroad managements are not called upon to face this problem because the continuous improvement of the steam locomotive which has effected economies to offset so much of increased operating costs in the past still offers attractive possibilities.

A great many mechanical engineers and other scientific specialists have been, and are still, devoting all their time to the study of locomotive problems The results achieved are truly remarkable Only a few years ago locomotives were built as large as clearance limits would permit with boilers of fifteen hundred horsepower. Clearance limits have not been increased but the capacity of boilers within those limits has been doubled It may be of some help in appraising this truly remarkable feat of compressing great power into small space to bear in mind that a stationary steam power plant of 3,000 horsepower would have half a dozen standard water tube boilers which, with the engines and auxiliaries supplied with steam, would occupy a ground area of ten thousand square feet or more and a height of forty feet as compared with the locomotive's length of 100 feet, extreme width of 10 feet 3 inches and extreme height of 15 feet

The average locomotive of 1,500 horsepower limit in size burned from six to eight pounds of coal per horsepower hour, representative types in large numbers are in service today developing a horsepower hour on three pounds of coal or less Some of the best designs use as little as two and a half pounds of coal per horsepower hour These results have been made possible in part by the perfection of the feed water heater which, by utilizing waste heat for raising the temperature of the water as it enters the boiler, to that extent decreases the amount of heat to be supplied by burning coal Other factors are the superheater and the more liberal design of the boiler made possible by the trailer truck Brick arches and other details have so increased the efficiency of the boiler that 70 per cent of the heat units in the coal burned in the firebox are transformed into effective power in the boiler

One of the possible future developments is in fuel and its efficient stoking Fuel involves not merely quality and the means of handling and burning but also the problem of supply If there were an unlimited supply of oil it would be a simple matter to transport and store supplies to transfer from the storage tank to the tender and to pipe from the tender to the firebox and thus solve the problem of stoking and efficiency of combustion But the world's oil supply is too scanty to permit its use as locomotive fuel except in a temporary and strictly limited way

It is, therefore, necessary to consider what can be done with coal, which varies so greatly in physical and caloric attributes It would greatly simplify matters if all coal for locomotive use were of the highest quality, free from sulphur and other impurities But it would not be economic to use the finest grades of coal for locomotive fuel exclusively and thus deprive other consumers whose requirements are more exacting

It has been suggested that the inexorable necessity of conserving the supply of fuel will compel us to develop on a commercial scale a process of treating coal which will provide a standard quality of fuel and save the other intrinsic values for other commercial uses The gases ordinarily freed in burning coal as fuel may be distilled and put in solution for use in automobiles and other internal combustion engines, while the coal tar products can be saved for their myriad uses in industry. It has been alleged that the intrinsic value of a ton of ordinary Pennsylvania coal is $25, and that its value for fuel is only one-fifth of this price The four-fifths irretrievable lost when the coal is burned as fuel, if properly conserved by processes already understood would yield the producers a handsome profit and provide locomotive fuel at a small fraction of present prices.

The automatic stoker has not yet attained perfection. By providing a combustible of the type indicated the difficulties in the way of efficient mechanical stoking will largely disappear.

Another promising field for improvement is in thermal efficiency, that is, the ratio of heat units converted into steam in the boiler to the total contained in the combustible burned in the firebox At present the best practice transfers 70 per cent of the heat units in the coal into the steam in the boiler Present progress encourages the hope that the standard may be raised to 80 per cent

In this connection it must be borne in mind that there is a marked difference between the thermal efficiency of the boiler and of the engines of the power plant Disregarding the small amounts of steam used by accessories such as the air pump, stoker engine, etc, and confining the comparison to the main power plant of the locomotive, the ratio of work done at the drawbar in terms of energy compared to the heat units delivered in steam at the top of the valve chest is 10 per cent A part of this loss is inevitable, regardless of whether the steam engine is mounted in a stationary plant or whether on the frame of a locomotive Mechanical friction is necessarily greater in a locomotive because of the limitations in weight and dimensions The average steam locomotive loses about 17 per cent of efficiency because of friction and its own weight

By far the greater loss is the latent heat of vaporization It takes one heat unit to raise a unit of water one degree in temperature from 211 to 212, and one heat unit to raise temperature from 213 to 214, for instance But it takes 700 heat units to change water into steam When the steam is exhausted from the locomotive and is condensed into vapor about 700 heat units are surrendered to the atmosphere About 40 per cent of this latent heat of vaporization is literally thrown away because no way of recovering it now exists on the locomotive In stationary power plants where abundant ground area and water supply are available to build condensing plants and even on shipboard it is possible to recover a large part of this latent heat A locomotive with similar facilities would probably be as long as an ordinary suburban train and of course, entirely impracticable. Present knowledge affords no way to recover this very large amount of wasted energy, yet it is within the bounds of future possibilities that a way may be found. The suggested possibilities of increasing thermal efficiency from 70 to 80 per cent are to be realized by the proper combination of known resources, such as improved superheaters, feed water heaters and perfected combustion.

Great mechanical improvement has been made in recent years. Electric welding has practically abolished the trouble from leaky flues Firebox surfaces are now stayed with flexible staybolts Outside valve gear readily accessible for repairs is now the standard. Ingenious devices for taking up wear in crossheads, wedges and other parts have come into extensive use. Mechanical stokers have made possible the introduction of locomotives too large for efficient firing by hand. There are pneumatic firedoors, electric headlights and many other devices unknown a few years ago. Still, the limits of possibility in mechanical development do not appear to have been reached.

One of the most recent improvements is known as "The Booster," which by utilizing the idle weight of the trailer truck and the surplus steam in the boiler at starting adds 20 to 35 per cent to the power of the locomotive at starting and enables it to "pick up" a heavy train very much more rapidly than would otherwise be possible. There are numerous other mechanical devices now in process of development which, when perfected, will still further enhance the efficiency of cylinders and machinery

Mechanically the tendency in the last twenty years has been to increase the weight of locomotives very greatly. This tendency, however, has its limitations and this introduces the factor of capital efficiency, that is, the ratio of capacity for doing work to the amount of investment. Weight has a direct reaction upon the investment in track, structures and all facilities with which the locomotive comes in contact. There is a point beyond which it ceases to be economical to strengthen bridges and increase the weight of track structure A locomotive materially heavier than a given standard might be theoretically far more economical than the standard but if its adoption involved the reconstruction of the whole railroad to stand up under the increased weight it would hardly be deemed a wise investment

By mechanical refinements already in process of development and increased thermal efficiency known to be attainable it will be possible to increase the capacity of the steam locomotive enough to take care of the increasing volume of transportation for the immediate future The question of electrification will then be thrown back where it belongs—it will rest on the ability of electricity to compete with steam, in capital expenditure and in operating economy. There will be less talk of electrification to meet the "breakdown" of steam

Wireless Telegraphy at Danzig

ACCORDING to the Danzig press, the Danzig telegraph office has recently installed a wireless press receiving station. These receiving stations, of which there are said to be about 120 in Germany, receive, for transmission to newspapers, press news distributed by wireless by the press services. In addition, the stations receive commercial news of the Bureau of Foreign Commerce in Berlin, intended for chambers of commerce, and also weather reports News is sent out by the main station in Königsmusterhausen.

The Danzig telegraph office is now operating four wireless stations. A station for the domestic telegraph service of the German wireless system; a coast station for communicating with vessels; the wireless press receiving station referred to above; and a special receiving station maintained by the *Danziger Zeitung*, a local newspaper, for its own messages.

The Polish authorities also possess their own wireless station, situated in the port district at Danzig-Neufahrwasser and used largely for communicating with vessels bringing government supplies. According to the press, the Polish station was specially authorized by the high commissioner and is subject to certain regulations in order to prevent interference with the operations of the Danzig, German, and British naval stations. For instance, the Polish station may communicate with Warsaw only between 1 and 3 A. M., and its conversations with vessels at sea must be confined to 10 minutes.

Developing One Million Horsepower from Tidal Energy

A Government Scheme for Distributing 500,000 Electric Horsepower Generated in a Barrage Across the Estuary of the Severn

IT is noteworthy that the first attempt to utilize tidal power for industrial purposes should be planned on such a scale of magnitude, that the resulting power plant will far excel any of the world's existing hydroelectric installations. The tidal hydroelectric scheme for utilising the energy of the 30-foot tide, which ebbs and flows in the estuary of the River Severn, is daring in conception and proves that its sponsors have the courage of their convictions. The huge dam, 3½ miles in total length, is to be built across the mouth of the Severn estuary, where the distance in an airline from shore to shore is 2½ miles. The 30-foot tide will flow through inwardly-opening sluice gates and will flow out to sea through a vast number of water turbines built within the dam itself.

In respect to its unprecedented magnitude this venture of British engineers will be in the same class in the field of hydroelectric development as was the construction of the great bridge across the Firth of Forth in the field of bridge engineering That the undertaking is no mere paper scheme is proved by the fact that it is being done by the Government itself, the plans having been worked out by the Civil Engineering Department of the Ministry of Transport

The Severn is particularly suitable for such a work because of its great range of tide, 30 feet at its maximum, and the fact that the estuary is of large capacity Also, the location is geographically well placed in relation to the industrial centers of Great Britain An interesting fact which explains why this work is being undertaken by the Ministry of Transport is that the predisposing motive for the whole scheme was the necessity for improving railway communication between South Wales and the rest of the country For some years there has existed at the proposed location of the dam a railway tunnel beneath the Severn, but its grades are heavy and it has no provision for road traffic, which, to get across the river into South Wales, must make a detour of some 50 miles by way of the city of Gloucester. The project is to build a vast low-level railway viaduct and roadway which will quadruple the capacity of the Great Western Railway Company's line between Bristol and South Wales, and it is out of the railroad and highway bridge proposition that the proposal to construct a dam for hydroelectric power has developed The topographical features are suitable for dam construction Near the center of the viaduct there is a deep channel with a rock formation on either side of it, and because of the excellent foundations thus provided, it was decided to follow the general line of the rocks and build the dam in the irregular form shown in our drawing The dam itself will be built of reinforced concrete, and its cross section will be of generous dimensions, sufficient to permit of housing the water turbines and generators within it

There will be two separate power plants First, there will be the turbines and generators in the dam itself, which will have a combined capacity of over one million horsepower and will be in operation during the periods when the difference in level between the water above and the water below the dam is sufficient to run the turbines efficiently It will be understood that these periods must necessarily be intermittent, moreover, because of the procession of the tides, they will vary from day to day. Hence, in order to secure a continuous output of power, it was necessary to provide an auxiliary plant which should run when the main plant was idle. This will be secured by building a dam across a valley which leads into the River Wye, a tributary of the Severn just above Tintern Abbey, and forming an auxiliary reservoir behind it

Since the total amount of electrical energy to be sent into the line for distribution is 500,000 horsepower, it is evident that there will be a surplus energy produced by the total million horsepower plant of the main dam, and this surplus current will be utilized in an electrical pumping station in the Wye Valley which will deliver water from the Wye to the above-mentioned high level reservoir When the tide falls to a level at which the turbines in the main dam cannot operate, the auxiliary turbo-electric plant of the Wye River will be operated by utilizing the waters which have been already pumped into the high level reservoir

It is proposed to supply for industrial and lighting purposes 500,000 horsepower for ten hours of the day. From the above description and from our plans, it will be understood that there are two huge power stations, one in the dam capable of generating a million horsepower, and one on the Wye of 500,000 horsepower capacity, so that the total installation will reach 1,500,000 horsepower During portions of the day, one or other of these plants will be idle, but for a part of the day, depending upon the state of the tide or the relation of the level of the water above and below the dam, the two plants will be working in parallel It should be mentioned that the water from the Wye will be pumped into the high level reservoir through a tunnel 40 feet in diameter, which will be driven for over a mile through solid rock

The ebb tide of the Severn runs for a longer period than the flood tide, consequently, the turbines in the main dam can work for about seven hours, the plant being idle for about five hours The main turbines will begin to work under a head about five feet, and about the middle of the seven-hour period, it will increase—on spring tides—to about 30 feet

Mixed-flow turbines with runners 10 feet in diameter will be used, since the speed, due to variation in head on the turbines, will be from 40 to 80 revolutions per minute The generator will be driven through a helical gear with a ratio of 7½ to one, so that the generator speeds will be between 300 and 600 revolutions per minute There will be a maximum rate of change of head of 10 feet increase or decrease in the hour Current will be delivered at a voltage of 525, and it will be passed through rotary converters and static transformers for transmission at 60,000 volts

The energy will be distributed to four different centers, first to the immediate locality of the power plant for the use of the industries which will grow up around the banks of the river, secondly, through the great

(*Continued on page 79*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

St. Paul Claims Its Own

To the Editor of the SCIENTIFIC AMERICAN:

The lift bridge illustrated and described in your issue of December 11, 1920, which your correspondent claims is located in Minneapolis, is in fact in the center of St. Paul and is not within five miles of the city limits of Minneapolis. Minneapolis always claims that everything of interest or prominence in St Paul is located in Minneapolis. St. Paul might with equal propriety claim that the beautiful concrete bridge in Minneapolis is located in St. Paul.

St. Paul, Minn. SPENCER E. SMITH

To the Editor of the SCIENTIFIC AMERICAN:

If you will get the envelope which this letter came in out of the waste basket, you will, no doubt, be surprised to see that it is postmarked Saint Paul. Strange as it may seem, we do not depend on Minneapolis for our letters, but have a postoffice of our own

We also have several department stores, a few hotels, and some theaters. We have our own street car system. We have nine railroads which stop here on their way to and from Minneapolis. We have our own city council, our own mayor, and our own representatives in Congress.

I will not go so far as to say that we are a city, but we have 285,000 people, and in time these figures may swell to such proportions that we will be known as the city of Saint Paul, and not as a suburb of Minneapolis.

In case I have not made myself clear, will say that any railroad bridge operating as an elevator or otherwise, which crosses the Mississippi River at Saint Paul, belongs to Saint Paul and not to Minneapolis.

I am not a subscriber to your magazine, and after hearing about your issue of December 11th, have no desire to become one. CLARENCE I TAYLOR

St Paul, Minn.

[*We are sorry that our Minneapolis correspondent should have displayed what we understand is a rather common failing of his fellow-townsmen—an inability to appreciate the fact that the Minneapolis city limits stop some five miles short of St Paul For our own part in the matter we feel less apologetic than usual where we have printed something that turns out not to be so. Strange and incredible as it may appear to Mr. Taylor, the editorial vision does not extend to the banks of the Mississippi, and for what goes on west of Jersey City we are actually dependent upon the written and pictured word of others. There doesn't seem to be anything about the bridge pictures submitted to us to suggest that the contributor was outside the facts in placing his bridge in Minneapolis—they have railroads there, and they have the river. When our contributor placed it at Minneapolis, we really think it would have been just about as sensible for us to suspect the bridge of being at Omaha or Memphis as to imagine that it might be at St. Paul*—THE EDITOR.]

The Foundation of Geometry

To the Editor of the SCIENTIFIC AMERICAN

If I have rightly understood your article on the parallel postulate it would seem that you desire to convey the impression that measurements should enable men to determine whether the space they live in is Euclidean or non-Euclidean

If this is really your stand I would like to make the following remarks:

It has been suggested that if space were Riemannian or Lobatchewskian the parallax of a distant star would be negative in the one case, or always finite in the second case. This would undoubtedly be true, providing we had assumed previously that the rays of light defining the angle of the parallax were geodesics.

But were we to assume that rays of light do not travel along geodesics we would be just as justified in assuming that space might be Euclidean.

The assumption we would adopt as to the nature of the trajectory of light would be dictated by convenience. Our conclusions as to the nature of Space would then themselves be dictated by convenience.

The acceptance or the rejection of the parallel postulate would simply amount to a definition of the way we intended to divide up the abstract concept of Space.

In the same way we might determine in advance whether a length should be divided up into meters and centimeters—or yards and feet, etc

For this reason the parallel postulate is incapable of demonstration since it is nothing but an arbitrary definition Until such time as we can prove that one line is a geodesic and another line is not a geodesic we can never discover by measurements the nature of Space, and until we can prove the nature of Space we are unable to determine what is a geodesic and what is not a geodesic, so we are turning in a vicious circle of argumentation

When, therefore, we say that Space is Euclidean or non-Euclidean, we simply mean that we find it more convenient to measure it Euclideanly or non-Euclideanly We will naturally choose the simplest method, taking into consideration the phenomena we come in contact with.

Until recent years the Euclidean way appeared the simplest on account of the large number of bodies in this universe whose movements coincide with more or less precision with those of indeformable solids. With the most recent discoveries of science, however, Einstein has shown us that taking everything into consideration the Lobatchewskian way was the simplest

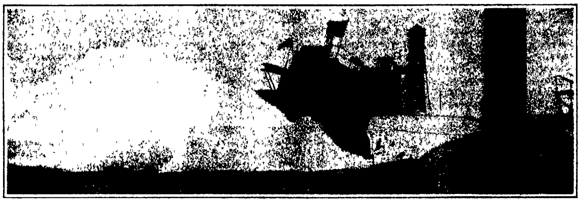
Calgary, Alta. A. d'ABRO.

[*The geometry of a given physical system may usually be made Euclidean or non-Euclidean at pleasure by proper manipulation of the dimensionality or proper arbitrary choice of the elements. The most familiar instance of this is the geometry of the spherical surface, which when we meet it in school is made to fit into the Euclidean three-dimensional structure, but which is simpler scientifically if not pedagogically when we look upon it as a two-dimensional Riemannian geometry, and we can build up a valid geometry of ordinary three space, using other elements than point and line—point, circle and sphere, for instance—to give us a non-Euclidean structure But after we have selected the elements which we are going to use in the geometry of space, we shall be able to determine what kind of a geometry they lead to.*—THE EINSTEIN EDITOR.]

A Daring Ship Design

Concrete Tankers Cast in Sections from Sliding Forms

By Ralph Howard



The sideways launch of the first of the sectional concrete tankers

ANOTHER "kink" in ship building originated during the war has demonstrated once more that ships do not always have to be built according to time-honored methods. Before the tremendous impetus given to shipbuilding in this country by the war needs, with the resulting development of new ideas, if we had been told that some one had proposed an oil tank ship built in sections by means of the ordinary sliding forms such as are used in the construction of the familiar concrete grain bins, these forms to be afterward joined together to make the finished ship, we might well have laughed at the apparent absurdity of the suggestion.

But in the successful launching of the 2,000 ton oil tanker "Durham" at Aransas Pass, Texas, recently, the seemingly impossible thing has been accomplished, for the vessel was built in just the manner outlined.

This unique tanker will be operated in carrying oil from Tampico to Aransas Pass, and its record in service will be watched with great interest because of its unusual design. A sister ship is nearing completion on the ways, and upon the success of these two vessels hinges the construction of a fleet of sixteen others. The boats are somewhat similar in outward appearance to the whaleback type of freighters used on the Great Lakes for transporting ore and grain, but that is as far as the similarity extends.

The builders of this craft secured permission from the Emergency Fleet Corporation, during the latter period of the war, for the construction of a fleet of reinforced concrete oil barges, and the design finally selected was one which possessed features that indicated considerable economy in construction as well as greater efficiency in operation than other types of barge design that had been considered. The original design for a tow barge was later changed to self-propelled tankers.

The body of the vessel consists of two interlocking cylinders connected at top and bottom by flat slabs, which form the deck and keel sections. The interlocking of the cylinders provides a passageway fore and aft through the hull that also serves as a buoyancy chamber from bow to stern. Bow and stern sections are ship-shape. The former affords space for chain lockers, stores, etc., and the latter for the internal combustion engines which drive the twin-screw propellers.

The oil cargo is carried in the main portion of the cylinder on each side of the central passageway, while the smaller chambers below the latter connect the oil compartments with the cargo pumps and the similar chambers above act as air-relief pipes connecting the oil compartments with ventilators at bow and stern.

The quarters for officers and crew are in a concrete deck-house amidships and the wheel-house is also located at this point. It is intended that the vessel shall carry twenty-five men.

The major portion of the hull is straight (210 feet long), divided into 7 sections by transverse bulkheads; thus there are seven compartments on either side of the buoyancy chamber. The total capacity of the tanker will be 14,000 barrels of oil.

Each 30-foot section was built in a vertical position by the use of sliding forms which are raised continuously by patented jacks, so that there are no joints or lines of cleavage in the individual sections. This method of construction has been used for a number of years in the construction of concrete grain elevators, but the present is the first attempt to use the system for concrete ship building.

Since these forms can be raised free of the completed sections, they are used again for building additional sections as required, thus securing great economy in construction. Each finished section was lowered by jacks on to steel carriers or "creepers" operating on railroad rails set in a concrete foundation platform 1,100 feet long, which was built alongside the launching ship to provide for the construction and assembling of the vessel. The section was moved forward into a tilting cradle, carried by shafts running through concrete supporting columns, and turned to a horizontal position, then placed on wooden cradles carried on the "creepers" mentioned and moved to final position in the ship.

Each cylindrical section was molded several feet short of the thirty foot length, but the rods used for longitudinal reinforcement projected beyond the upper end and were joined with similar bars of the adjacent section when placed horizontally in position on the ways.

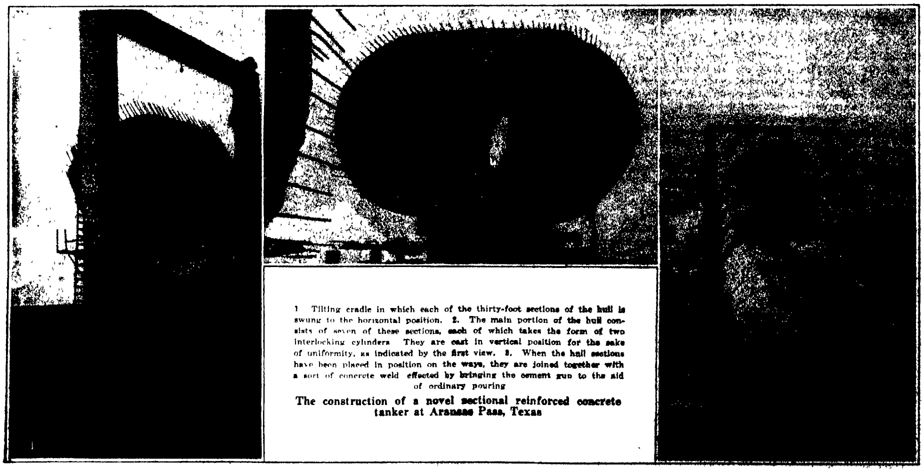
The open joints formed between sections were concreted by shooting each edge of the joint with a cement gun to obtain a good bond and at the same time filling with concrete the space between.

The stern section was built in fixed forms in its proper position on the launching ways, but the bow section was built and moved into position after all of the cylindrical sections were placed.

Construction of the first two tankers of this novel design was delayed by the terrific Gulf hurricane of September 14, 1919, which destroyed the construction buildings and much of the supplies and equipment, but the concrete hull sections finished at that time were not damaged. In spite of this discouragement, the work was resumed and, though greatly delayed, has been steadily pushed to a conclusion.

The concrete used in building the tankers was a

(*Continued on page 79*)



1. Tilting cradle in which each of the thirty-foot sections of the hull is swung to the horizontal position. 2. The main portion of the hull consists of seven of these sections, each of which takes the form of two interlocking cylinders. They are cast in vertical position for the sake of uniformity, as indicated by the first view. 3. When the hull sections have been placed in position on the ways, they are joined together with a sort of concrete weld effected by bringing the cement gun to the aid of ordinary pouring

The construction of a novel sectional reinforced concrete tanker at Aransas Pass, Texas

1. Ladle of molten steel being poured into the sand mold 2 Mold partly finished. To complete the mold forty-seven cores are required for forming the hollow or lattice-like portions of the casting 3 Cleaning the casting after it has cooled in the mold and has been removed from the flask 4 The final casting, cleaned and with heads removed, ready for annealing

Four steps in the production of huge steel castings for the main frames of battleship electric motors

Casting Steel Motor Frames for Our Electric-Drive Battleships

ONLY comparatively recently have American battleships been propelled by electricity instead of steam To do this involved radically new machinery and equipment, some of it of extraordinary large size According to present plans all new battleships and cruisers are being equipped with electrical driving mechanism

For the propulsion of such massive ships by such power, the motors must be very large. To meet the unusual stresses or strains the castings that go to form the motor frames must be of steel, not iron

One of these large main frames is shown in one of the illustrations and an idea of its magnitude is obtained by comparison with a man The production of such a casting, which in its finished state weighs 25,000 pounds, is very difficult It is made or poured in a sand mold which is made in a large flask in a large pit or hole in the ground The flask is 18 feet square and 5 feet 6 inches deep To complete the mold 47 cores are required, the cores forming the hollow or lattice like portions of the casting One illustration shows a mold partly finished while another gives an idea of the pouring of the casting with a ladle of hot steel, the immense flask in the pit which forms the mold being also visible The final casting after it has cooled in the mold and has been removed from the flask, ready for cleaning and about to be cleaned is pictured in another view. The many protrusions are the various risers or heads of steel which are necessary to all steel castings and which feed the solid portions of the casting as it cools and contracts

The final casting, when cleaned and the heads removed, is annealed in a large annealer and then shipped in specially constructed cars. The completed casting is beautiful as steel castings go, and is about 17 feet in diameter and 4 feet 6 inches high The castings are being made by a large steel casting company.

Dyewoods in Demand

MANUFACTURERS of natural dye extracts are having a difficult time at present, they state, in obtaining satisfactory supplies of the basic raw woods which are obtained from foreign lands, principally the Indies, both East and West. They state that importers are not bringing in sufficient quantities of these woods to meet the needs of extract makers, despite the fact that prevailing prices are virtually four times higher than the prices prevailing in 1914. Importers, on the other hand, assert that the bottom has been knocked out of the dyewood market by the enlargement of the manufacture of synthetics in the United States and they have lost much of their previous interest. They admit, however, that there is a large business still to be done in the tanning industries which are heavy consumers of dyewoods, but many have passed up the possibility of this business on the ground that returns are not sufficient for the investment required at present prices

Meanwhile, continues *The World's Markets* extract makers are finding that if they want to get any supplies of raw woods, they must import them directly for their own use and a number of them have taken steps accordingly, though much against their inclination to go into the import business This is especially so as to logwood and fustic These have been selling consistently for months at $60 to $80 per ton as against $15 to $20 in 1914. Others include Brazilwood, quercitron and quebracho

Imports during the current year to date as compiled by the U S Government, show that the logwood arrivals totalled some 48,863 tons and imports of other woods totalled 2,938 tons These figures represent a considerable increase over the figures for the corresponding period in 1919, but by far the greater proportion of the imports this year has been made by extract manufacturers directly, as many importers have stopped bringing in these woods this year and some have done little since the war ceased They assert that the previous policy of consumers has not been of a kind to work to the best interest of the importers and they decline to renew this class of trade Nevertheless there is good business waiting for such importers as care to take hold, it is stated by the extract makers And in view of the marked slump in ocean freight traffic, such an enterprise is most opportune

The reason why Americans have suddenly turned to buying wooden shoes in Europe: Automobile washers wearing wooden shoes

Wooden Shoes and Automobiles: Why Sabots Are Imported

AT first thought there seems to be no relation between wooden shoes and automobiles But one never can tell these days Wooden shoes play an important part in auto building Indeed they probably reduce the cost of autos by six and three-tenths cents each—if figured out by an efficiency expert

Automobile chassis have to be washed after they are built and before they are taken to the big room where the bodies are put in place for after that all ablutions have to be administered very carefully For this all-over bath soft soap is used—pails of it—and the water is applied with a hose

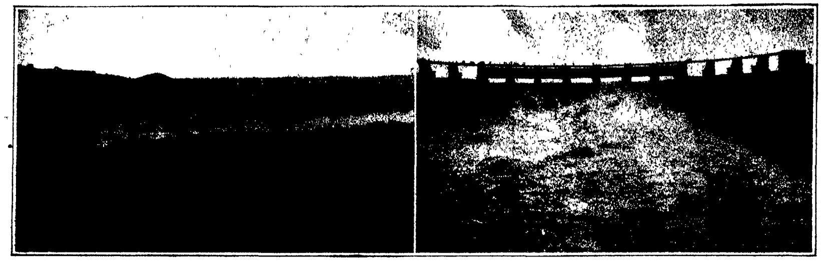
At first the auto companies provided high rubber boots for the men who did the work, but they soon found that soap and rubber did not agree, and that the bill for rubber boots was quite an item And when the war came on, and the price of rubber soared, indeed it became quite appalling

So some bright young man got a lot of wooden sabots—brought from Holland or somewhere for actors—and tried them out The workmen stuffed paper tightly in around their feet and encircled their legs with pieces of old slickers and found that the result was very satisfactory when worn with the usual apron The shoes got soaked through in time, of course, but by keeping two pairs in use for each workman—one to wear and one to dry no trouble was had

But during the war, nobody in either Holland or France or anywhere else in Europe could guess what the mischief Uncle Sam wanted with so many wooden shoes Some people thought Mr Hoover was saving leather for the Allies, others thought that we were trying to show our affection by contenting ourselves with what the Allies had to put up with, and still others insisted that the Reds wanted them to throw into machinery that was making munition But nobody guessed that they were "to wash autos in"

Chemicals from Gas Residuals

THE Chemical Works Department of Glasgow Corporation, which was instituted about 18 months ago, as an adjunct of its gas department, for the purpose of manufacturing chemicals from the gas residuals, will, it is expected, help to reduce the cost of gas to consumers. It was the custom until about a year ago for the corporation to dispose of the residuals to private firms from which it received a sum for the use of the buildings and equipment and a certain amount for the materials When the chemical department was formed experiments were carried out which resulted so favorably that the municipality decided to terminate the contracts with the private firms and to undertake the work itself.



Left: **Balboa at Pacific end, showing entrance to dry dock, coaling plant, oil tanks, shops and radio station. *Right:* The spillway and channel in center of Gatun Dam. View taken when it was discharging the overflow of Gatun Lake. Maximum capacity, 187,572 cubic feet of water per second, which occurs only during floods of the Chagres**

our-masted steel sailing vessel being towed through Culebra Cut by two tugs

Panama Canal Facts

How the Panama Canal Saves Time and Distance

THE Panama Canal extends in a general north and south direction from the Caribbean Sea to the Gulf of Panama, and it is located between the eighth and ninth parallels of north latitude It runs through a strip of United States territory known as the Canal Zone which extends five miles on each side of the center line of the Canal At the Atlantic entrance is Colon, a city of 30,000, and at the Pacific end is the city of Panama, with about 65,000.

The French began work on the Canal January 20, 1882. The French rights were purchased by the United States Government on June 28, 1902 American occupation began May 4, 1904, and on August 15, 1914, the Canal was opened to commerce.

This great waterway is a lock canal. It was built by forming fresh-water lakes in valleys on either side of the Continental Divide and connecting these by the stretch of canal in the Culebra Cut through the Divide Gatun Lake has a surface elevation of 85 feet above tide water Descent is made to the ocean on each side by double locks in three steps.

The length of the Canal from deep water to deep water is 43.84 miles of which 12 76 miles are sea level section and 31 08 nautical miles consist of lakes and locks

The width of the channel in sea level sections is 500 feet, in Gatun Lake, 500 to 1,000 feet, and the bottom width in the Culebra Cut varies from 300 feet to 600 feet On account of the great slides, the maximum width across the Cut (at Culebra) between the outer edges of slides is about 3,000 feet The number of locks is twelve, arranged in pairs, the number of lock gates is forty-six, and the total weight of the steel in all the gates totals 60,000 tons The concrete used in all the locks totals 4,500,000 cubic yards

The depth of water in the Atlantic section is 41 feet at mean tide, in the Pacific section, 45 feet at mean tide, and the depth of water in the Lake and Cut sections is from 45 to 85 feet, while the elevation of the bottom of the Canal in the Gatun Lake above sea level is 40 feet.

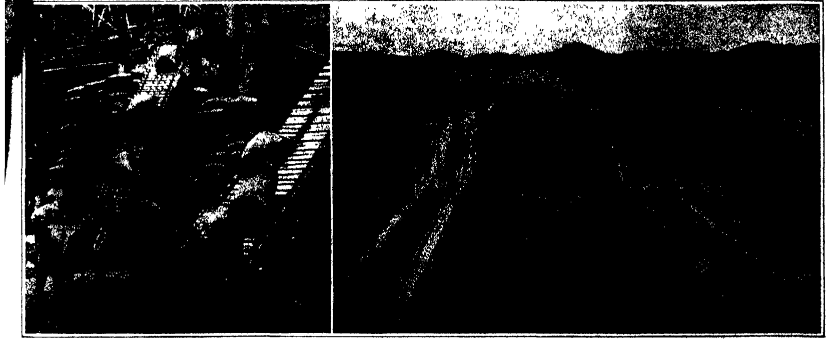
The total excavation done by the French that proved useful in the revised American canal was 27,708,000 cubic yards The additional excavation necessitated in taking out the slides was 62,052,000 cubic yards; and the total excavation from the channel is about 252,133,000 cubic yards. In point of magnitude the greatest single work at the Canal is the Gatun Dam, which is 1½ miles in length, ½ mile thick at the bottom, and 100 feet at the top The elevation of the crest is 105 feet above sea level, and in building the Dam, about 23 million cubic yards of material were put in place. In the center of the Dam is a spillway 808 feet long, capable of discharging 187,572 cubic feet of water per second The total cost of the Canal to date is approximately 375 million dollars

The number of commercial vessels which had used the Canal to January 1, 1920, was 8,887, carrying 33,668,313 tons of cargo, and there is a steady growth in the traffic. The accompanying diagram, showing the nationalities and the respective numbers of vessels which have passed through the Canal, reveals the influence of our war-built merchant fleet in giving our flag adequate representation. The bulk of the 2,911 United States vessels that have used the Canal must have passed through it in the post-war period

The purpose of the United States in cutting through the Isthmus of Panama at a cost of nearly 400 million dollars was to shorten the ocean trade routes of the world, and particularly to bring our Atlantic and Pacific coasts closer together by avoiding the long voyage around Cape Horn There was also the military advantage of enabling our warships to pass expeditiously from the Atlantic to the Pacific and vice versa, thereby obviating the necessity for maintaining two separate fleets

The accompanying diagram shows how great a saving of time, distance and costs has been secured by the opening of the Canal The voyage from New York to San Francisco has been shortened from 13,135 to 5,262 miles, a saving of 7,873 miles A vessel sailing from New York to Callao steams only 3,363 miles as against 9,613 miles by the Straits of Magellan, a clear saving of 6,250 miles Vessels bound from Liverpool to San Francisco save 5,666 miles

Increasingly, as the traffic has grown, the Canal has become self-supporting, and in the fiscal year ending June 30, 1919, the revenues earned in excess of current expenses were 241,822 dollars This estimate does not include any allowance for depreciation or any interest charges on the capital investment of 365,415,985 dollars.



Left: **Elevators piling up cargo inside Government pier sheds at Cristobal. *Right:* Miraflores Lock, looking toward Miraflores Lake. Note the Lake spillway to the right of the locks**

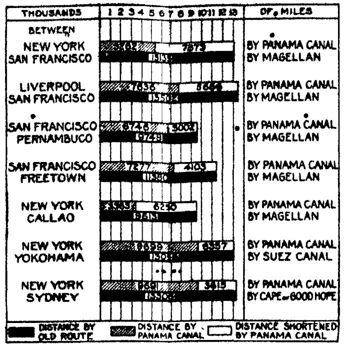
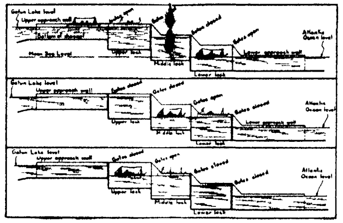
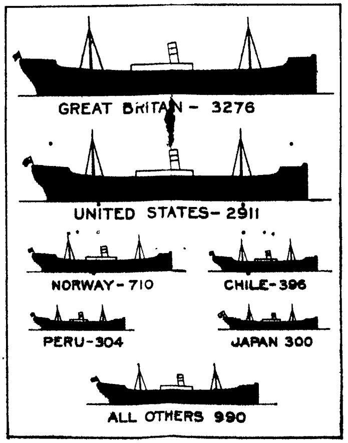


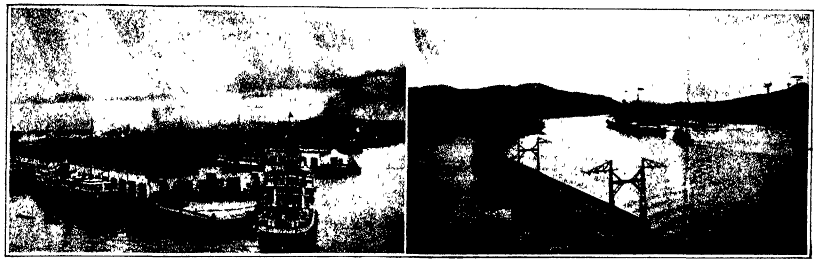
Diagram showing distance saved on various steamship routes by making use of the Panama Canal. Thus, distance from New York to San Francisco is reduced by three-fifths



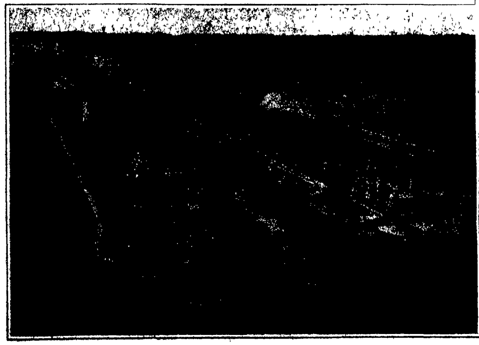
Diagrams showing the successive operations involved in raising a ship from the Atlantic Ocean level to Gatun Lake level by means of the three flights in the Gatun Locks



This diagram shows nationalities and respective numbers of vessels which passed through the Panama Canal from its opening to January, 1920



Left: **View of the new Government piers at Cristobal at the Atlantic entrance to the Canal. Canal also provides coal, fuel, oil and water storage for the supply of shipping. *Right* A stretch of the Canal showing the cruiser "Renown" passing through the Canal with the Prince of Wales aboard. To the left is the Panama Railroad**



Left: **This view shows ten United States Destroyers in the middle chambers at Gatun Locks when our Pacific fleet passed through the Canal. *Right:* Floating crane "Hercules," 250 tons capacity, at Gatun Locks. The Canal has two of these cranes**

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H E HOWE, Chemical Engineer

Transporting Chemicals

IN the May number of the *Chemical Age* there is given under the heading, Transportation of Chemicals by Ship, the British Board of Trade provisions for sea shipment of chemicals. Specifications as to size of packages are quoted followed by specific remarks concerning the shipment of 16 materials. Many of the restrictions would be expected by the average chemist, but a chemist is not always at hand when a cargo is being stored away. Sodium chlorate may be cited as an example. "The chlorate should be packed in iron drums, or if that is not possible in paper-lined casks of sufficient strength not to allow any of their contents to escape when subjected to rough usage. Casks or drums containing the chlorate should not be stored in the same hold with combustible materials, or should be separated from such substances by a partition. They should not be stowed in the neighborhood of the strong mineral acids especially sulfuric acid, in such a manner that any escaped acid could reach the chlorate. *Not more than ten tons of chlorate* should be carried in one hold."

Dry Dyeing

A FRENCH patent has been issued and noted in the *Color Trade Journal* for June for dyeing materials such as cotton, silk and velvet by a dry method involving carbon tetrachloride, with which ammonium gallo-trioleate is precipitated as a mordant by the electric current. After mordanting in an iron vat, in which a wire basket is fitted with electrical connections, the dyeing is brought about in a bath containing 200 parts of carbon tetrachloride, 75 parts of alcohol, 20 parts of mordant, and 10 parts of dye for 30 parts of fabric. The color is fixed on the fiber by the action of the electric current, and after dyeing the fabric is dried in air, well rinsed in a 2 per cent solution of the mordant in benzene, and is finally washed in pure benzene.

Opportunities in Government Laboratories

THIS is not an appeal to scientists to accept appointment in Government laboratories, but a reminder to the industries that opportunities do exist for them in many of our Government laboratories. Several of the establishments could undertake researches of direct benefit to industry if support could e given through special coöperating arrangements, or actually placing men on the fellowship plan to nefit by the direction afforded and the equipment ailable. This is particularly true at present when ome of the laboratories find themselves unable to aintain an adequate staff with the funds at their isposal. Not only is opportunity afforded in this way o extend the boundaries of our knowledge, but to imrove the training of the men so placed by their employers.

Lubricating Abrasive Wheels

A PATENT has been granted covering a method for *lubricating abrasive wheels*. This consists in immersing the wheel, previously heated to a temperature above the melting point of the filler, in a molten bath of the chosen material. The filler thus penetrates the pores of the wheel, which upon removal from the bath is rotated while the filler is still molten so that the excess may be flung off. One of the satisfactory fillers mentioned in the patent comprises a mixture of paraffin and rosin.

Japanese White Leather

THIS leather is made by first soaking dry hides in a river when the water is not too warm, or for a longer period earlier in the year, until the hair will slip. The hides are then washed and shaved and tramped with salt, after which they are packed in a cask and left from one to three days. They are now ready to be bleached in the sun, but on dark days the hides are trodden to prevent mottling of the grain. As soon as crystals begin to appear on the grain side *of the leather this part of the process is considered* finished. It is a difficult problem to decide when this stage has been reached. The salt is now removed by soaking but a small quantity, determined by tasting, is allowed to remain. The hides are next dried, then sprinkled with water, and oiled on the flesh side with rape seed oil. By tramping again for half a day the oil goes through to the grain side. The hides are then exposed to the sun again, treaded the second time, washed with water, again treaded, and again bleached in the sun.

The color should now be white, even the yellow tint of the oil being bleached out. After storing for one or two months the hides are again bleached for a few hours, more of the salt is removed by soaking, followed by another exposure to the sun, another soaking until just wet through, another treading, followed by staking. This round of sunning, treading and staking is repeated until finally they are damped over night and stretched for a final drying in the sun.

The product after this six months' process is soft, tough, and white.

Keeping the Factories Running

THOSE who are still wondering whether the dye industry is entitled to adequate protective legislation may be interested to know that there are 67,585 *separate establishments* in the textile, paper, leather, and allied industries which are dependent to a greater or less degree upon supplies of dyestuffs. Over 2,000,000 people are employed in these factories, there is an investment of four billion dollars, and they produce about 25 per cent of our country's total output of manufactured products.

Spark Plugs

IN report No 53 of the National Advisory Committee for Aeronautics, A. V. Bleininger discusses the preparation and composition of ceramic bodies for spark plug insulators. The porcelain of spark plugs must resist high temperatures, mechanical stresses, and sudden great changes in temperature. The porcelain must remain a good electric insulator, must be strong and tough and have a constant thermal expansion. The composition of one of the best types expressed in per cents is Georgia kaolin, 10, Florida kaolin, 10, North Carolina kaolin, 10, Delaware kaolin, 10, *calcine*, No 19, 40, and calcine No. 14, 20. These calcines are made up as follows. For No 19, kaolin, 70.2, alumina, 27.8, and boric acid, 2.0. For calcine No 14 kaolin, 56, precipitated magnesium carbonate, 18.2, and potter's flint, 25.8. A number of formulæ are given in the report.

Chemistry and Fire Protection

COPIES of a report submitted at the National Fire Protection Association meeting governing regulations for the storage, handling and use of such materials as celluloid, pyralin and similar nitro-cellulose compounds may be had from the secretary-treasurer of the association, 87 Milk Street, Boston. The products covered include many plastic substances having soluble cotton or other nitro-cellulose compound as a base, and the rules are applicable whether the material be in solid form like sheets, tubes or fabricated shapes, or be prepared as a lacquer enamel, thinner or cement.

Training the Consumer

THE War Service Committee of the Women's City Club of Boston is continuing one of its active projects, namely, a clothing information bureau which seeks to become a center of information and service for those who desire help on the problems of textiles and clothing. This is another step toward making it possible for anyone to know the truth concerning what they buy, and the program outlined is one which if it can be followed should soon make it necessary for the merchant to rely more fully upon the laboratory than most of them have heretofore been willing to do.

Among the points upon which the consumer should be trained are knowledge of the cloth, manufacture, dyeing and finishing of textiles; methods of testing the value of cloths before purchasing them; knowledge of the properties and values of the four leading textiles, and the necessity of learning where reliable materials are made, so products of such factories may be demanded. A point is made that *the trained consumer* should be in a position to require honest information from the sales force and from advertisements, and that a merchant prepared to give this information, much of which is only obtainable through the laboratory, shall be rewarded by sustained support of his establishment.

The Bureau affords opportunities to test cloth before purchasing it.

In Canada one of the great department stores has established a research bureau which works in the interests of the ultimate consumer just as much as of the establishment. It seeks to prevent misrepresentation in the weight, measure, substance or purpose of any form of merchandise. The laboratory serves in many lines of chemical analysis and tests, because of the diversity of materials offered by the establishment. It acts in an advisory capacity to the department buyer and sees to it that even the advertisements correctly describe the merchandise that is offered. Wool is made to mean all wool; linen, flax fiber; silk, natural silk, and if its source is otherwise, some name such as fiber silk must be used. Unlike most establishments, this one indicates furs by their actual names as well as the trade name under which they are more frequently sold.

Titanium in Enamels

IN a recent number of the *Journal of the American Ceramic Society*, Landrum and Frost describe a series of experiments with titanium enamels. Some of the conclusions drawn indicate that the most promising factor of the possible use of routile is shown in the unusual durability of such enamels under all tests. The chemical resistance is much greater than is the case of ordinary enamels and the high gloss produced gives a surface resistance to abrasion and the consequent speedy failure of the enamel after the surface is once broken is largely avoided. Such enamels also have a higher heat resistance. There is difficulty, however, in maintaining a satisfactory state of suspension *of the titanium oxide in the frit. It seems that* titanium oxide has no place in the ground coat, and while there are several technicalities to be overcome the final conclusion is that the good qualities more than offset the bad ones and that it should be possible to develop enamels containing titanium which would have very marked practical value.

Cast Iron in the Light of Recent Research

THIS is the title of a book by William Herbert Hatfield, a second edition of which has recently been reviewed in the *American Technical Press*. It is a fairly complete compilation of numerous discoveries made through research during the last half century. Beginning with the work of Turner on the influence of silicon in cast iron, the book brings together practically all the important papers scattered throughout the journals from 1885 to 1918. The book although written from the viewpoint of English metallurgy is one that will be appreciated by the American metallurgist and those concerned with improved foundry practice.

Utilizing Scrap Leather

SOME scrap leather finds its way into the fertilizer industry, and recently a British patent was granted for the production of a substitute for ordinary leather from scrap. The patent describes the process as one which first reduces the scrap leather to a powder, after which it is cleaned with oxalic acid and then mixed with an adhesive made of liquid glue, boiled linseed oil, carbolized oil and oil of cloves. This mixture is formed into sheets.

Another patent gives as a formula for a leather composition 16 pounds of rubber, 20 pounds of leather reduced to flour-like subdivisions, 5 pounds of calcine magnesia, 6 pounds of sulfur, 8 pounds of brown factis. If a hard vulcanite is to be made 32 pounds of rubber, 60 pounds of leather flour, 16 pounds of sulfur, and half a pound of magnesia are used.

In this process, waste or reclaimed rubber is reduced between rolls and then an intimate mixture of leather flour, etc., is added, followed by the small amount of factis or other fatty material, after which the whole is comminuted. The temperature of the rolls is then brought to a point to cause partial vulcanization, after which it is put through calender rolls and reduced to sheets while *the final temperature is raised* to 240° F. The sheets, a sixteenth or twentieth of an inch in thickness, are superimposed alternately at right angles to produce greater strength.

The composition described is also used for coating canvas, for upholstery, etc., and in sheet form finds use as boot soles.

The Car That Goes Anywhere

IF you are the proud possessor of the kind of automobile that sells for $440 without a starter and $510 with, you are doubtless well acquainted with the way to justify such ownership in the eyes of your friends who sport eight-thousand dollar limousines and chummy racers. The principal argument in this eternal debate over the never-disposed-of question "Why is a flivver?" usually simmers down to the claim that said flivver will "go anywhere" We produce herewith two photographs that may well qualify as exhibits for the defense in this case of Sporty Six, Expensive Eight and Tremendous Twelve vs. Tin Lizzie.

The motor sled is nothing especially new, but we do not recall having seen one that has been converted from an ordinary automobile with quite so little change as the one shown in our first view For the front axle assembly with its wheels has been substituted a runner outfit, suspended from the springs, which it will be observed have been turned upside down and shifted from their usual lateral position to a longitudinal one in preparation for this change. At the rear end there has been no necessity for such modification. The photograph shows distinctly a valve-cap protruding through the rim, which may be taken as confirmation of the impression which one gets that the tires have not even been removed. Traction in the snow has been secured by the attachment of an outer sheet-metal tread with wooden cross pieces—aside from this a rear view of the machine would present the customary appearance of a stripped chassis of this car. Doubtless when conditions in Nome, Alaska (the residence of the owner) approximate those of summer driving, he goes back to the summer style of vehicle, and is grateful that he has been able to follow the manufacturer's instructions with regard to the removal of the rear wheels—"Don't remove them"

The other ingenious modification of the car that goes everywhere is for the purpose of making it go where many owners would hesitate to send it—into the water The forward part of the car, containing carburetor, ignition system, and everything else that would effect the running of the engine if submerged, is housed in the body of a big flat-bottomed craft, and the rear axle is suspended over the stern of this craft, just nicely out of the water This owner has found it necessary to remove the tires, for obvious reasons; then he has fastened six broad wooden blades to each wheel, bolting them between plates that in turn are secured to holes in the rim so that they stand up from the rim to the necessary height. The result is an admirable gasoline launch, which is steered from the wheel of the chassis in quite the usual marine fashion, and which gives its owner, again an Alaskan, a big lift toward capturing his share of the salmon run.

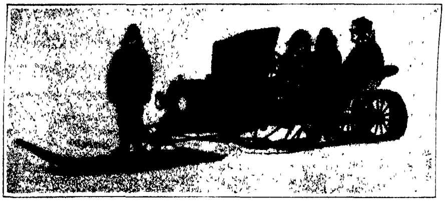
Sweet Potatoes as Stock Food

SWEET potato silage is a comparatively new contribution to an already variable ration for live stock in the South, a series of experiments covering a period of years as conducted by the agricultural experiment station of the University of Florida determining its fitness as a stock food. As a major crop in the Southern States, equalling in value that of the upland cotton acreage in Florida, its use in sustaining cattle during the winter months enhances its appreciation as a farm product.

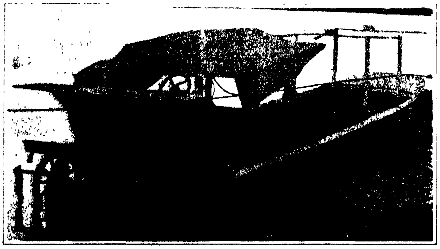
Sweet potatoes, diverted from the storage house to the silo, are run through the ensilage cutter in the same fashion as corn or other products converted into silage. The storage facilities as now in vogue involve a loss of thousands of dollars in sweet potatoes in the South; whereas, among the virtues claimed for the conversion of the tubers into silage are the absence of loss from storage, reduction of required space for preservation and no waste in feeding

Chemical analyses of sweet potato silage and corn silage fail to disclose any appreciable difference The former has a moisture content of 54.87 per cent, crude protein 1.82, nitrogen-free extract 39.41, fiber 1.48, fat 0.66, and ash 1.85 per cent Silage manufactured from matured corn analyzes as follows: Moisture 73.7 per cent, crude protein 2.1, nitrogen free extract 15.4, fiber 6.3, fat 0.8, and ash 1.7 per cent Feeding experiments in Florida have justified the claims that 100 pounds of sweet potato silage will replace from 150 to 200 pounds of corn silage in the ration The uneven ratio favoring the feeding value of the potato product is attributed to a minimum water content, and the presence of two and one-half times as much nitrogen-free extract as the corn silage

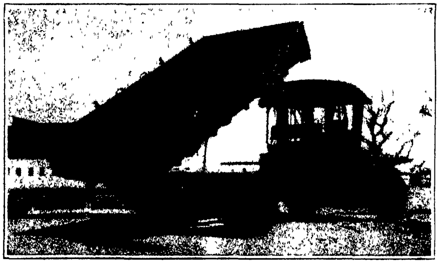
Comparative tests to ascertain the relative feeding values of sweet potato silage and sorghum silage in the production of milk yielded the following results The cows subsisting on sweet potato silage, wheat bran, and cottonseed meal produced 2,641 pounds or 307.1 gallons of milk For a corresponding period of time, cows fed sorghum silage, wheat bran and cottonseed meal yielded 2,415.8 pounds or 280.9 gallons of milk



The flivver of the snows, as improvised from the temperate-zone model, with an absolute minimum of dismantling and no real structural modification



Another extension of Lizzie's vogue, which adapts her for the propulsion of light boats



A recently introduced dump truck of novel design, in which is produced an adjustable chute that makes it possible to deliver stone at the side of the road

This novel method of loading makes it possible to ship five trucks on every flat car, in place of the two which has always been considered the limit

The Truck that Dumps at Any Angle

THE New York State Highway Commission has lately designed and placed in operation a uniform type of truck body for use in construction and maintenance work on the highways of the State

The truck body is 12 feet in length and 6 feet in width The body is mounted with a hydraulic hoist so that it may be used as an end or side dump body. The side sections may be removed entirely leaving a platform for hauling asphalt or other materials of that sort in barrels The side sections may also be removed singly so that rock or sand may be dumped to the side in various sized piles as required

An adjustable chute inserted into an opening provided in either side of the end gate makes it possible to deliver stone at the side of the road instead of only in the middle A sliding door operated by a hand lever situated below the center of the end gate provides the opening necessary for the admission of the chute The load of rock may be dumped in the middle of the road after removing the chute

Shipping More Motor Trucks to Each Flat Car

LACK of transportation facilities of late years has called for no end of ingenious improvisations Shippers have had to alter their packing methods in order to take advantage of all transportation facilities, both usual and unusual A case in point is shown in the accompanying illustration, which shows how one motor truck manufacturer has been shipping his vehicles in flat cars in such a way as to get five trucks in where formerly only two were carried As will be noted, the first truck is placed at the forward end of the flat car, with all four wheels resting on the floor The next motor truck's front wheels rest on the platform built over the first truck, while the rear wheels rest on the floor The third, fourth and fifth trucks are arranged the same way, with their front wheels held high by means of props, while their rear wheels rest on the floor of the car In this manner five trucks are accommodated in the flat car, the only restriction being the height of the load which must take into consideration the clearance of the railroad right-of-way

Inventions New and Interesting

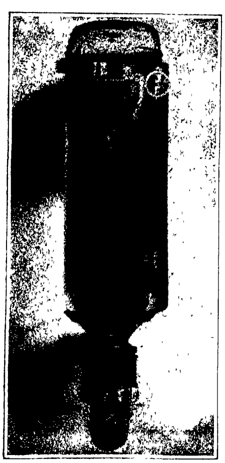
A Department Devoted to Pioneer Work in the Arts

Working the handle back and forth advances the plow bit by bit

A One-Man Plow for the Horseless Farmer

AN ingenious German has invented a one-man plow which has been tested at various agricultural exhibitions with conspicuous success This plow, which is shown in the accompanying illustration, is operated by working a handle back and forth A novel arrangement of levers causes the plow to advance bit by bit as the handle is worked. Needless to say here, the process must be a slow one and no doubt calls for considerable muscular effort, as compared with the horse-drawn plow But then they do not mind hard work in Germany, and time is not the quintessence of farming, especially in small-scale operations

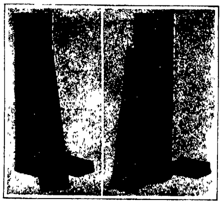
A similar idea is in the form of a man-drawn plow, which is being developed in France for small farmers



The fusing of the automatic fuse head at the bottom of this extinguisher releases the contents

Something New in Tank Development

A NEW developing tank for photographic films and plates has recently been invented by a Canadian, Chas G Brambrick, of Brooks, Alberta The tank is made of sheet metal and is long and narrow, as it has been found that the chemical solution for developing plates and films keeps much longer in a tank so designed The tank contains a number of holders which are designed to accommodate either roll films, cut films or glass plates The holders have an adjustable edge which holds the negatives securely to the holder. The tank forms a most convenient and economical means of developing either films or plates or both in quantities



A tank for developing films and a similar tank set up for holding plates

A Fire Extinguisher That Operates Automatically

GREAT strides have been made in recent years in the application of chemicals to the fighting of fire, making it possible to extinguish the more modern dangers, namely, the fires of electrical origin Then, too, the overhead water-piping systems with automatic sprinkler heads, while expensive, have marked a great advance

But with the advent of the automobile, with its highly explosive fuel and its electrical equipment offering endless opportunity for short circuits and consequent fire, a new problem developed. The worst feature of an automobile fire lies in the fact that the blaze attains headway so quickly that staying to operate the pump type hand extinguisher usually recommended for that purpose, is exposing the operator to great danger The safest course is to keep away The car should not be protected at the expense of life

It has remained for Harrison H. Boyce, an inventor of Brooklyn, N Y, to develop an extinguisher which is automatically operated in the face of fire. Briefly, it is an aquamarine glass container holding a fire-destroying chemical sealed under pressure, which is sprayed out in a wide circle of vapor upon the melting of an automatic fuse by the fire itself The vapor in contact with the heated air changes to a dense blanket of gas which instantly smothers the fire down to the tiniest spark, according to the claims of the inventor The fusible member is simple and positive in operation

When the fire extinguisher is to be used by hand, the operator simply holds it with the metal end up, unscrews the fuse end, and dashes the contents at the fire. The chemical, retaining some of the pressure, is slightly effervescent and rushes out of the container with considerable velocity The action of the chemical on the fire is the same as in automatic operation

Needless to say, the new extinguisher need not be limited to use under the hood of an automobile It can be used in the home, shop store, shipping room, and elsewhere By means of a bracket four automatic extinguishers can be mounted overhead in factories.

To Lock Your Car, Take Off the Wheel

SOMETHING a little bit different in the way of a convenient and thief-proof steering wheel is shown in the accompanying illustration In the first place, this wheel might well be called the fat man's friend It does not merely tilt up a little way--it tilts clear over to the front of the steering column, so that anybody who can sit in the driver's seat can get out of it with as little trouble as it costs him to stay in it In the second place, this full tilting feature is supplemented by a very simple means of detaching the wheel completely The manufacturer very sensibly suggests that if you take off your wheel and take it with you when you leave your car no thief is going to molest it A steering-wheel lock that can be broken is of no effect after breaking has been effected, but a car without a steering wheel, while it is conceivable that the thief might find some way of moving it, would cry "Stop Thief" to high heaven and certainly cause the arrest of its occupant before he had got very far with it

An ingenious combination of electric fan and electric heater

An Electric Fan That Heats, Cools and Dries

AN electric fan of the type shown in the accompanying illustration will heat a room and also keep it cool It is an electric fan fitted with a combination powerful heater having a nichrome element Thus the fan may be used to blow a current of heated air. It is claimed for this fan that by actual tests it will raise the temperature of a room quickly and at relatively economical cost

The heating element of this novel fan consists of special resistance wire wound in spiral form on strips of mica, arranged radially as shown The guard, instead of being made entirely of wire members, has a cylindrical shield, as shown, for the purpose of concentrating the heat so that it can be distributed by means of the current of air created by the fan.

Steering wheel that tilts all the way over and is detachable too

A Jardiniere That Waters Itself

FROM France comes the self-watering jardiniere invented by M Pinson of Paris This novel device consists of a jardiniere with double walls. The space between these double walls is used as a reservoir for holding a certain amount of water, and dipping into this water are a number of tubes bent in the form of siphons and arranged symmetrically, each containing a wick Capillary attraction causes the water to be drawn up the tubes and around the bend of the tube, after which the water drops down on the earth contained in the flower pot placed in the jardiniere If the water is found to flow too freely, the wicks can be trimmed so as to curtail the flow. Depending on the capacity of the jardiniere, sufficient water can be placed in the retaining space for as much as two months without attention.

Copyright, Keystone View Co.

Wicks and siphons cause this jardiniere to water the plant without attention

Paper From Alaska

(Continued from page 64)

problems and several methods of logging would likely be used on the same general operation.

In 1918 $8.95 was the average cost for raw pulpwood at the mills in California, Oregon and Washington. It is believed that pulpwood can be produced much cheaper in Alaska, as the bulk of the wood will be cut within less than a mile of the water's edge Figures of $4 to $6 per cord would normally approximate average conditions even under present primitive methods of logging.

Construction from the ground up summarizes the requirements to be met in Alaska, which is still a comparatively raw and undeveloped country. Following the acquisition of the timber and source of power, the mill site and town could then be advantageously located. The site would need to be cleared before construction could begin. A sawmill would no doubt be required and the first logging would be for the clearing of a mill and town site, and the building of necessary structures, such as wharves, storehouses, mills, dwelling houses, offices, machine shops and stores.

The mainland and islands of southeastern Alaska are generally mountainous, and there is little level land either as upland area or along the shores Along much of the coast line the hills and mountains rise abruptly and the dense forest growth, extending down to the level of high tide, overhangs the steep banks The islands are separated by an intricate system of waterways and fiords, known locally as straits, canals, channels, passages, sounds, narrows, inlets, bays, coves and arms, some of which reach far inland. Many of these waterways are very deep and can be safely navigated by the largest ocean steamers, but some are so shallow as to be navigable only at high tide by boats of moderate draft The coast and entrances to harbors are rocky and in places the greatest care is necessary in order to avoid rocks that are barely submerged. The topography is so rough that only in favored localities or at great expense can wagon or tram roads be constructed. The waterways are, therefore, of great value in affording routes of communication between this region and the Pacific Coast ports of the United States Indeed, were it not for water transportation the mining and quarrying industries in southeastern Alaska could scarcely have been developed. Fortunately the timber which would be used is situated along the coast and on the large islands of southeastern Alaska and as previously stated, on the Tongass National Forest

Every Automobile Its Own Elevator

(Continued from page 65)

ing stories, it is generally necessary to alternate their positions from floor to floor in order to give the ascending and descending cars ample space in which to maneuver. In leaving one ramp and in approaching another This arrangement takes up a good deal of valuable space and, besides, is apt to impose architectural difficulties and to call for a disposition of piping for heating, drainage, water supply, etc, which is much more complex than where the leads are alike on every floor.

Nevertheless, the ramp is desirable, for it promotes rapid travel up and down through the building and the freest movement to and from the street Further than that, where numerous cars or trucks are concerned, congestion of traffic in front of the structure is reduced to a minimum. But the present and the steadily rising price of real estate, especially in populous and busy centers, makes it imperative that the warehouseman, the manufacturer, the storekeeper, and the garage operator, shall get the fullest returns for every square foot of floor space, and thus reduce the overhead charges as far as possible And now we come to a type of ramp that constitutes a novel and a very valuable development in the art one that has all of the virtues of the usual ramp with worth while characteristics peculiar to itself It is the invention of Fernand E d'Humy, an experienced American engineer, who was inspired primarily to better the housing facilities offered by the run of city garages His problem was to evolve a modified form of ramp and a type of structure to go with it which would abridge the inter floor rise and, therefore, the length of the ramp His scheme, as now evolved, permits the use of his motor ramps in tall buildings of many stories

Broadly, the fundamental plan calls for a structure divided longitudinally or transversely into two sections by a central wall, with the floors of the neighboring divisions staggered or half a story apart Manifestly, a motor vehicle, passing through the dividing wall, on the ramp, would have only half a story to climb or to descend in going from one floor to the other Therefore, the ramps themselves need not be more than 40 feet long with a maximum gradient not exceeding 15 per cent Horizontal space is economized by giving the ramps a curve, which incidentally makes it easier to control a descending car and to swing it into the next ramp unit Accordingly, one complete turn on the ramp suffices to carry the vehicle a whole story upward or downward on either side of the dividing wall

Compared with a number of recent garages equipped with the ordinary ramp construction, the d'Humy motor ramp makes it possible to house on the same floor area from seven to twenty additional cars. But this does not cover all of the material advantages The d'Humy motor ramp can be placed in the center of a building, where it will in no wise interfere with natural lighting, and therefore leaves the best illuminated sections for the storage and the overhauling of the machines Next, a matter of vital concern, the cars or trucks can move in or out freely in a continuous stream, either to meet the rush-hour service period or to take care of them when they are homeward bound in large numbers Where conditions justify it, duplex concentric ramps or separate twin ramps would be provided to take care of the vehicular tide—one line for the up-bound and the other for the down-bound traffic

It will be observed that there are no moving features, and neither electric current nor operators are required to make the ramps themselves available It is estimated that the working charges for the elevators of a 5-story garage, capable of housing 400 cars, would total quite $4,380 yearly, and none of the trucks or cars could be got out of the building or stored if the power supply failed Picture the risks run if fire threatened from a near-by building aflame! With the d'Humy structure, on the other hand, however high, all of the cars ready to be driven could be removed in short order, and it is quite likely that those with empty fuel tanks could coast down and get out of harm's way.

What applies to the garage is equally true of the factory, the warehouse, the great department store, etc No matter on what floor are located the goods to be shipped or on what level incoming materials are to be delivered, the motor ramp enables the automotive truck or car to get there with dispatch and under its own power In many manufacturing establishments of magnitude, raw materials as well as finished and partly finished products are moved about on the several floors by electrically-driven industrial tractors hauling strings of trailers. But when a train of these helpful carriers has to go up or down to other floors it is necessary to break up the train and

(Continued on page 79)

in the long run

Neverslip Lock Washers

will increase the value of your product

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There is one way by which you can make certain that each nut and bolt on your product is delivering a maximum efficiency in gripping power, and that is by using the

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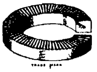

LOCK WASHER

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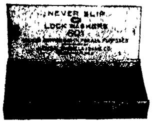

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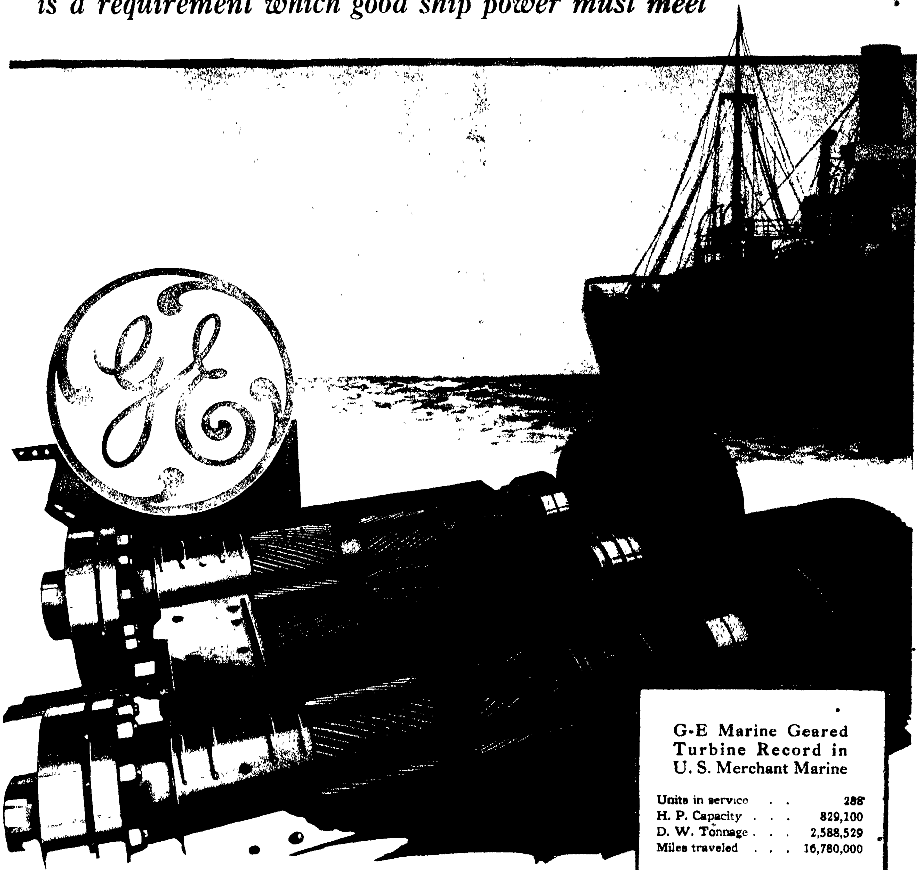

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Units in service . .	288
H. P. Capacity . . .	829,100
D. W. Tonnage . . .	2,588,529
Miles traveled . . .	16,780,000

This nation had 144 Marine Geared Turbine vessels in service during the war—G-E equipment on 95 gave 81 per cent of the total service

Type of gear so successful on this ship - cover removed
Manufactured by
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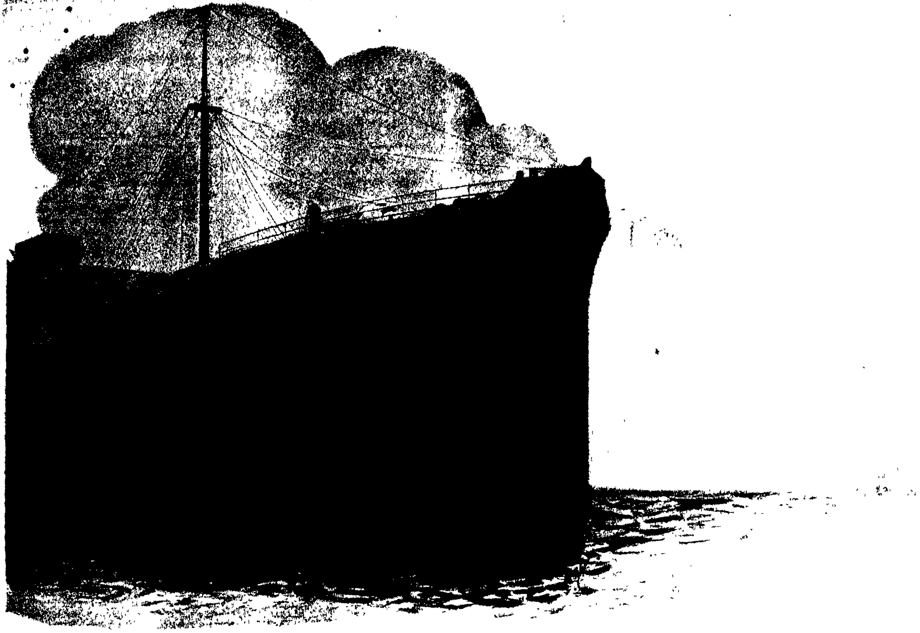
Visit the G-E Exhibit at the Second Annual National Marine Show, Grand Central Palace, New York City, Jan. 24-29

GENERAL



Niels Nielsen on her trial trip

The Atlantic tested this Propulsion Set

FOR more than three years, the Niels Nielsen has plied steadily between the eastern United States seaboard and ports of France and Spain. She is 409 feet long and has been averaging 12050-ton loads of general cargo.

In her engine room today, showing only moderate wear, is a

G-E Curtis Turbine with Double Reduction Two-Plane Type Gears

which have propelled the boat 140,655 miles (August 1, 1920) since the very day she went into service.

The performance of propulsion machinery like this and of the duplicates driving those other long-service pre-war ships the Pacific, Eurana, Sucrosa and Hanna Nielsen, has won the confidence of skeptical, conservative men of the sea for the 1920 type of G-E Two-Plane Type Marine Geared turbines. This type embodies all the strength of its predecessor plus lowered tooth pressure, better tooth design, greater weight, less length and a more perfect uniformity of load distribution due to slip type pin couplings.

[illegible]-17

ELECTRIC

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

COVERING I J Cahill, 238 N 12th St, Philadelphia, Pa The invention relates to a wing covering more particularly adapted for airplanes which will render a tearing of such covering extremely difficult and prevent it from spreading The covering includes a woven material and rows of stitching in said material extending at an angle to the weave of the same The covering material could also be used as an envelop for the ballonnets of a dirigible

Pertaining to Apparel

MATERNITY SKIRT —C M Goldberg, 388 St Nicholas Ave, New York N Y This invention has for its object to provide a maternity skirt with a box plait having an outer portion to which a belt is secured, the inner portions of the box plait being continuous with the body of the skirt so that the plait may be increased or decreased, and the fullness of the body of the skirt correspondingly decreased or increased to fit the skirt of the wearer

APRON —W P Sharp, 161 Jefferson Ave, Columbus, Ohio This invention has for its object the provision of an apron, or, in fact, any body garment provided with a waistband adapted to encircle the waistline, to be combined with means for retaining such garment in applied position without the aid of any of the conventional fastening means, such as tapes, buttons, or snap fasteners, and without loss of any time, the garment including a waistband and a resilient strip incorporated in the band

Electrical Devices

SEPARATOR FOR STORAGE BATTERIES —H T Robberg, Castana, Iowa An object of the invention is to provide a separator which is of rubber composition and which will be a perfect insulator, which will outlast ordinary separators and at the same time be comparatively cheap to manufacture A further object in using this material is to permit a battery to discharge at an unusual high rate and to cause a battery to quickly take the charge when in discharged condition

TROLLEY POLE —J J Reggio, 2028 Dumain St, New Orleans, La The invention relates more particularly to a construction whereby the trolley wheel when it leaves the trolley wire will be automatically lowered to a point below the wire and the wire suspension system so as to prevent injury to the latter trolley wheel or pole The invention is so designed as to be readily applied to trolley poles already in use simply by cutting out an intermediate part and inserting the new construction

Of Interest to Farmers

PLOW —E B Karn, Parma, Idaho This invention relates to plows adapted to be drawn behind a tractor and especially designed for use on irrigated land, or where it is desirable to throw all the furrows the same way, where in a plurality of gangs of plows is provided, oppositely arranged and adapted to be brought into operative position in alternation, and connected in such manner that they may be elevated out of contact with the ground and reversed to bring either gang into operative position

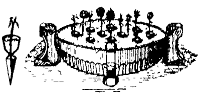
MOWING MACHINE —J S Wheeler, c/o Mesa Garage, Mesa, Ariz The invention has for its object to provide a mowing machine of the multiple sickle type and a form of connection between the sickle blade and the mowing mechanism thereof the machine is especially adapted for use with sickle mowers of the tractor type When the machine is in motion it is so arranged that there will be two cutting strokes of the sickle for each movement of the pitman in each direction

Of General Interest

SHAVING KIT —R H Ball Danville Va Some of the principal objects accomplished by the invention are to provide a simple compact and sanitary kit for a shaving outfit in which provision is made for separating, ventilating and drying the lathering articles forming part of the outfit and for receiving and separating the razor sections in order to prevent rattling by the contact of the parts with one another

STRAINER —L Taub, c/o Mac Taub Specialty Co, Suite 406, 51 53 Leonard St, New York, N Y The invention relates to strainers for cooking utensils, particularly tea-pots, coffee pots and similar utensils The prime object is to provide a means in which the strainer is adjustable with respect to the pouring spout of the utensil regardless of its position on the body thereof

FLOWER OR PLANT HOLDER —G W Schimmel, Newtonpein, 49a, The Hague, Netherlands An object of the invention is to provide a flower holder which can be forced into a bed of earth or other granular material and which will hold the flower or plant in upright position A further object is to provide a holder which permits the flowers to be positioned in the bed without the necessity of first preparing holes to receive the same

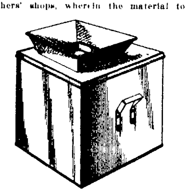


VIEW ILLUSTRATING AN ORNAMENTAL BED AND THE HOLDER

SNOW PLOW —S W Gass, Tenino, Wash An object of this invention is to provide a snow plow which can be conveniently employed in clearing sidewalks, streets, and the like, and which may be either pushed or pulled A further object is to provide a snow plow which will embody all necessary strength and durability and which can be manufactured at a reasonably low price

DISH P R Simmons, P O Box 103, Huntington, Ind The object of the invention is to provide a dish for serving ice cream, comprising a permanent holder and a replaceable container fitted in the holder A further object is to provide a simple and inexpensive dish of suitable material for this purpose which can be securely held against displacement when the dish is in use, but easily removed or replaced at will

SANITARY CONTAINER —M Mislikowsky, 11 Jefferson St, Yonkers N Y The object of the invention is to produce a garbage receptacle particularly adapted for use in butchers' shops, wherein the material to be thrown away may be tossed into the mouth of the receptacle and will be automatically conveyed to the receptacle body, whereupon the closure provided will automatically close and form an airtight seal between the interior and exterior of the receptacle



A GENERAL VIEW OF THE CONTAINER

Hardware and Tools

DRILL GAGE —L B Webster, 3813 Euclid Ave, Cleveland Ohio The invention has for its object to provide a flexible transparent gage which can be positioned around a twist drill and the like and which contains a scale consisting of lines at different angles relative to one edge of the device and which scale registers with line of the lip clearance of the drill to indicate the angle of the said line

AUTOMATIC PLUMB BOB —E S Bush, 5133a Minerva Ave, St Louis, Mo The object of this invention is to provide a bob wherein the supporting cord is connected to the weight in such manner that when not in use the cord may be automatically wound up within the bob, and wherein any length of cord may be withdrawn and the bob clamped to the cord to restrain the operation of the winding up means until it is desired to release the same

COMBINATION TOOL —R H Dean, Leeds, Sioux City, Iowa Among the objects of this invention is to provide a tool which performs a number of functions in connection with the valves of internal combustion engines, and is particularly adapted for use in connection with the removal of the valve on the engine cylinder, to raise the rocker arm and also to compress the valve spring to permit a release of the pin in the valve stem holding the spring assembled thereon

DRILL TIGHTENING AND LOOSENING JACK —S La Point, 1018 E Jefferson St., Tulsa, Okla The invention relates generally to jacks, and particularly to power jacks, the primary object being the provision of a quick adjusting double acting arrangement, more especially an arrangement of this kind which is simple in construction and positive and efficient in its action The invention is particularly adapted to the tightening and loosening of drilling tools in oil well operations.

Heating and Lighting

STOVE CASING —J C R Abernathy, c/o Manual Training School, Pullman, Ill The invention has for its object the provision of a casing for covering a cook stove to conceal the mechanical features thereof while not interfering with the passage of heated air and not interfering with the use of the stove in its cooking capacity, the case being formed with holes registering with the holes in the top of the stove and closable by removable lids.

INCENSE BURNER AND LAMP.—Lillian M and W A Rhodes, address Wm. A Rhodes, 195 Broadway, New York, N. Y An object of this invention is to provide an incense burner and lamp with an opening in the top of the lamp for permitting the rays to be projected from the lamp and also for permitting the escape of smoke from the incense burner so that an illumination of the smoke will be provided without affecting the usual illuminating results secured by the lamp.

Machines and Mechanical Devices

GAUZE FOLDING MACHINE —M Willner, 191 Stanton St, New York, N Y The object of the invention is to provide a device wherein gauze or other narrow strips of cloth may have the edges folded and then folded along a central line in a continuous operation A further object is to provide a folding device for bandage gauze now in common use in hospitals wherein the parts will fold the gauze and then wrap the same into a disk, folding same so that the raw edges will be turned in

GATE VALVE LOCK —F R McCarthy and E C Combs, 418 N Osage, Ponca City, Okla This invention has for its object to provide a gate valve lock which will be effective to securely incase and protect the operating stem or similar operating means of the valve and preclude the possibility of unauthorized persons opening, closing or otherwise changing the adjustment of the valve

FRUIT CLEANING MACHINE —A O Moe, Toppenish, Wash An object of this invention is to provide a fruit cleaning machine more especially designed for subjecting apples and similar fruit to a repeated wiping and brushing action to insure thorough cleaning and polishing of the fruit without danger of bruising the same A further object is to provide for the cleaning of a large number of apples in a comparatively short time.

CLOTH HOLDER FOR CUTTING TABLES. —M Breit and T R Atkinson, 200 5th Ave, New York, N Y The invention particularly refers to attachments for holding the ends of layers of cloth on the table during the cutting operations Among the objects is to provide a device including a weighted arm for direct holding contact with successive layers of the cloth and supporting means adapted to hold the arm in different elevated positions above the pile of cloth, and a counter or tallying device coöperating with the weighted arm for registering the number of piles of cloth

Musical Devices

AUTOMATIC WINDING DEVICE FOR PHONOGRAPHS —S A and R I. Wolfrum, 3825 N Springfield Ave, Chicago, Ill The invention relates to electrically operated winding devices for phonographs An object is to provide a device which may be attached to the ordinary spring driven motor for operating phonographs, by means of which the motor may be wound by an electric motor, or manual means as desired

CABINET FOR PHONOGRAPHS OR TALKING MACHINES —R R. M. Hall, address D M Hall, 2412 6th Ave., W., Seattle, Wash. This invention has for an object to secure the most desirable results of sound and tone in the use of talking machines. Another object is to provide a cabinet which can be used with the conventional talking machines that will much improve the functions of the same The construction is particularly adapted for use in large public places, large rooms, or outdoor work

Prime Movers and Their Accessories

SPARK PLUG —L Enright, Farmingdale, L. I., N Y. The invention relates to internal combustion engines, its object is to provide a spark plug arranged to securely hold a central electrode insulated in the plug body without danger of producing a short circuit. Another object is to dispense with the usual porcelain insulating tube by providing an insulation which is not liable to break, and which when placed in position in the plug forms a permanent part thereof.

Pertaining to Vehicles

SHOCK ABSORBER —M. G. Reed, Brookville, Pa This invention has for its object the provision of a construction wherein means are provided which will not prevent a free up or down initial movement of the wheel or axle, but will yieldingly resist a return movement. A still further object is to provide a pair of spring pressed pivotally mounted members arranged to produce friction when the axle moves up or down independent of the body of the vehicle

STEERING DEVICE FOR MOTOR VEHICLES —J W Price, Genl. Delivery, Tulsa, Okla The object of the invention is to provide a mounting for the front wheels, wherein the spindles are rigid with the wheel hubs and are journaled in bearings in forks on the ends of the front axle to swing on vertical axes, to permit the steering of the vehicle, the device is dust proof, having a minimum of friction, and is capable of being quickly assembled.

RADIATOR FOR WATER-COOLED MOTORS —R F Eskens, 596 4th Ave., Astoria, L I, N Y This invention has particular reference to means for causing the rapid cooling of a relatively large volume of water by a forced circulation of air drawn from outside of the front part of the machine, the air being caused to circulate upward through the water and serving thereby to extract the heat. The water chamber is so designed that water is maintained in a large volume without subdivisions, thus reducing the danger of freezing

STEERING KNUCKLE —J S. Baird, 2525 W 36th Ave, Denver, Colo The invention relates to steering means for the front wheels of automobiles, its general object is to provide a knuckle which is stronger than the steering knuckles generally employed, as well as insuring the element of safety, such as will resist side stresses as well as jars and jolts, and desined to better distribute the burden of the load weight imposed thereon The device may be easily assembled or disassembled and conveniently installed

STEERING GEAR —O S Pulliam, 208 W. 58th St, New York, N Y. This invention has as its primary object to provide a steering gear in which the shocks to which wheel steering wheels are subjected are prevented from being transmitted to the steering gear and hand wheel The device comprises a disk member having a spiral slot or groove and a rocking lever, one end of which projects into the groove in such manner that as the disk is rotated the lever will be rocked with a subsequent movement of the steering wheels.

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Every Automobile Its Own Elevator

(*Continued from page 75*)

to depend upon elevators to transport a few units at a time—again making up the train when the desired level is reached. The motor ramp is designed so as to avoid this interruption to speedy transfer and lends itself to the inter floor travel of these trailer trains in their entirety.

Without further elaboration, it should be self-evident that the d'Humy system is susceptible of meeting a very wide range of service demands, and may be the means of doing away with operations that now occasion much loss of time and the imposition of heavy charges. Finally, let it be said that the immediate future of the automotive industry is dependent upon the prompt providing of ample garage facilities in our principal cities. Many a prospective car owner is hesitating because he cannot be sure of a convenient place in which to house such a vehicle, and it is likewise vital that these accommodations be offered at prices that will be in keeping with the average purse. The motor ramp, as Mr. d'Humy has conceived it, seems to offer the relief so much desired. His solution of a vexed problem is so simple that one wonders why it has not been developed before.

A Near-Diesel Engine for the Airplane

(*Continued from page 65*)

two pistons per cylinder, it possesses no valves.

As shown by the illustration the pistons are opposed *head on* there being two separate crankshafts, one for each six pistons. The two crankshafts are connected by gearing at one end of the crankcase. One piston uncovers the intake ports when it nears the bottom of its stroke and the other piston uncovers the exhaust ports. The exhaust ports are larger and are uncovered first. The cycle of events during one complete revolution is as follows, beginning with the piston at top dead center on the compression stroke. A measured quantity of fuel has just been sprayed into the chamber through the nozzle seen in the bottom of the sectional drawing. This spreads through the highly compressed pure air in the combustion chamber. Just then a spark occurs and ignites the mixture. The pistons move out simultaneously until the exhaust ports are uncovered by the left piston. A large part of the burned gases escapes at once to the big annular chamber surrounding these ports. Then as the pistons move a little farther the intake ports are uncovered by the other piston and a charge of pure air surges in, sweeping before it the burned gases and driving them out of the exhaust ports. By the time that the intake ports are covered by the return stroke of the piston all exhaust gas has been driven from the cylinder and nothing but pure air remains. Air is delivered to the intake ports under slight pressure imposed by a blower built into one end of the engine. Continued inward movement of the two pistons compresses the air and when the pistons are close to upper dead center a new charge of fuel is injected, a spark occurs and the cycle is repeated.

The weight per horsepower is low (1.5 pounds) because there are twice as many power strokes as in the ordinary engine. The reliability of the engine is increased because the engine is very much simpler than the usual four-cycle type in that it has no valves, although the fuel injection apparatus and the double crankshaft nullify this advantage to some extent. The engine is in perfect balance since the in and out movements of the reciprocating parts in each cylinder absolutely cancel each other. Better fuel economy is obtained because higher pressure is used, exhaust back pressure is eliminated (referring to the pressure on the exhaust stroke in a four-cycle) and because the Diesel cycle is inherently more efficient. It is safer against fire since the air and gasoline are not mixed except within the cylinder walls.

Developing One Million Horsepower from Tidal Energy

(*Continued from page 67*)

industrial area of South Wales, thirdly, to the English Midlands, of which Birmingham is the most important center, and fourthly, there will be the supply of the Thames Valley and London which is 115 miles from the power station.

A lock capable of passing the largest ocean vessels will be built near the center of the dam at the upper end of the channel into which the turbines discharge. Vessels will be towed through this channel by electric towing engines, moving on each wall of the dam, and the lock will be provided at each gate with a bascule bridge for the passage of railway trains and shipping.

The area of the deep water basin above the dam will be 27 square miles. Along the banks will be built suitable piers, warehouses and storage yards to accommodate the shipping and freight. On the land back of the docks will be erected the various industrial plants which, as at Niagara, will be drawn to the Severn by the prospects of cheap building sites, abundant electrical power, and good rail and shipping facilities.

A Daring Ship Design

(*Continued from page 68*)

mixture of one part cement to one part of crushed coke, ½ inch and smaller, which gave a weight of 110 pounds per cubic foot exclusive of reinforcing, as compared with 150 pounds for ordinary concrete.

The thickness of shell was greater in these vessels than would ordinarily be used, because of the omission of transverse framing. Thus the concrete of the cylindrical sections is ten inches thick at the bottom and seven inches at the top. The interior surface of all oil compartments was given two coats of spar varnish, and the outer hull surface painted with a bridge cement.

The first tanker was successfully launched sideways July 24th and found to draw almost exactly the calculated amount of water. The second tanker will be ready for launching shortly.

Each vessel is 298 feet long overall, 33 feet 9 inch beam and 21 feet 10 inches deep. The full load draft will be 18 feet.

"Koka Seki" and Its Uses

"KOKA SEKI" is a variety of pumice stone which, as far as now known, reports Vice Consul H. T. Goodier of Yokohama, is only found in the small group of Niijima Islands (New Islands), which lie off the coast of the Idzu Peninsula about 90 miles south of Tokyo. Though used in Niijima from ancient times as a building material, only comparatively recently has "Koka Seki" become known commercially in Japan proper. Because of its durability, high tensile strength, and capability of resisting 1,300°C of heat, it is suitable for boiler and furnace construction as well as inner linings of safes and the manufacture of ice chests. As it is claimed, it can be easily cut, will take a surface of paint or metal plating, and as nails can be driven in it it is thought that the uses of this material will greatly increase. It is, however, in reinforced concrete barge building in Japan that it is best known. This concrete is stated to be about 60 per cent lighter than the ordinary kind, and is said to be absolutely resistant to seepage, water erosion, or serious breakage by freezing and thawing. An estimate cost of such a reinforced concrete barge with a cargo capacity of 180 tons is given as $6,979, or in orders of five vessels each, as $5,982 apiece. The current prices of "Koka Seki" in Tokyo are about 1 yen ($0.50) per cubic foot for blocks, and 33 sen ($0.17) per cubic foot for flakes and sand.

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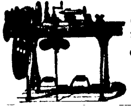

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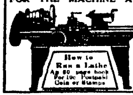

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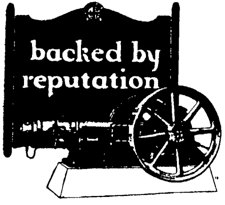

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---

(14359) C E C asks: Please tell me through your Questions and Answers Department how to drill holes through glass A To drill glass, prepare a solution of camphor in turpentine and add some ether While proportions are not very important, a good solution is made by taking spirits of turpentine 1½ oz, camphor 1 oz., and ether 3 drams. Break the tip from a 3 cornered file so as to have a sharp and very hard point, dip the tip of the file in the solution and give it a twisting motion on the glass where the hole is to be made Use sufficient pressure to cut the glass but not to break it Practice will soon enable you to do the trick Work on odd pieces of glass till you get experience Be very careful when the tip of the file is about to come through the glass After the hole is made it can be enlarged to any size by a round file Keep the glass constantly wet with the solution

(14360) F A says Is it a fact that in Norway water power is used to extract nitrogen from the air which is used as a soil fertilizer? If so, how is it done, and in what form is the nitrogen applied to the soil, as a liquid or as a gas, I do not think that it could be successfully mixed with the soil in the form of gas It has always seemed wonderful to me that plants of the legume family are enabled to withdraw nitrogen from the air and by storing it in their roots enrich the soil for other plants, but it also seems wonderful if this process can be duplicated by mechanical means and if you have ever printed an article on the subject I would be very glad to forward stamps for it A Nitrogen is taken from the air in Norway by water power The water power drives a very powerful dynamo by which an enormous electric arc and tremendous heat are produced The air is driven through this arc and the heat forces the nitrogen and the oxygen of the air to combine into an oxide of nitrogen, which passed through water, becomes nitric acid This in turn acts upon broken limestone and forms calcium nitrate which is a fertilizer It is by causing the nitrogen to combine with oxygen that the nitrogen which is taken from the air is able to become useful as a fertilizer and also in making explosives such as smokeless powder, nitroglycerine and dynamite Nitrogen cannot be employed as a gas or as a liquid for any of these purposes Certain plants of the legume family have small nodules, or bunches, on their roots In these nodules there are bacteria which are able to cause the combination of nitrogen in the gaseous forms with other gases to form substances which can act as fertilizing agents Nitrogen uncombined is of no value in manufacturing or in farming In ammonia or nitrates it is very valuable everywhere, and in many ways. The United States Government is now building large works for making nitrates from the air

(14361) R S S. says A friend, a citizen of one of our great allies who by his various remarks indicates that he begrudges us much of the well merited credit for our part in the world war, has made the statement, on the authority of one of our great university presidents (who, however, may have been misquoted), that not a single scientific development, invention or innovation of any sort has been made by an American during the world war which played any part in bringing about its successful conclusion for the Allies I appreciate that this may readily be true without detracting from the glory gained by our arms, but it occurs to me that this statement may be challenged I would therefore greatly appreciate information regarding the following questions, which I write down off-hand and also any additional accomplishments to which you can refer me, tending to refute the above statement.

(1) Is Dr. Alexis Carrel an American and did he not discover the "irrigation method" in the treatment of wounds?

(2) Was the "depth bomb," as used in U-boat warfare, an American invention?

(3) Was the "smoke screen" first proposed by an American as a weapon against the U-boat?

(4) Was the submarine detector (acoustic device) developed to a practical point and was it an American development?

(5) Who first proposed "camouflage" for ships as a defensive measure against the U-boat?

(6) Was a practical "static neutraliser" for wireless developed and was an American its inventor?

(7) Was wireless telephony used practically in the war, by whom, and who perfected it?

(8) Was field artillery with so-called split tail-pieces used exclusively in the American army and was it an American development?

(9) Did we develop new poison gases and did they come into use?

(10) Was the Browning gun used to an appreciable extent by our troops?

(11) Assuming the "Liberty motor" possessed many points of merit over other aircraft engines, was its design solely American and were they used in appreciable quantities by our fliers?

A—(1) If we are not misinformed, Dr Carrel is an American citizen of French birth. We understand that he developed the treatment mentioned

(2) The "depth bomb" was developed in the destroyer service and, we believe, was perfected by the American force abroad

(3) The "smoke screen" was first used by our destroyer fleet in naval maneuvers against the battleship fleet prior to the recent war.

(4) There are now several excellent "listening devices" in use, some French, some English and others American We believe that the American device was first used successfully

(5) The English used camouflage prior to our entry into the war

(6) We know of no "static neutraliser" for use with wireless that is as satisfactory as a good operator There is a current saying that "static" varies inversely with the proficiency of the operator

(7) The most satisfactory use for wireless telephony with which we are acquainted was in the "submarine chaser" flotilla. It was an American development

(8) We regret that we are unable to answer this inquiry

(9) Several types of gas were developed in this country and used abroad, more especially along the lines of "mustard gas," "lachrymal gas," etc, which were temporarily incapacitating

(10) The Browning gun was not manufactured in large quantities in time to be much of a factor

(11) The "Liberty motor" is supposed to combine the good points in practically all automobile and aeronautic motors It was entirely an American development The actual delivery of motors in quantity did not start in time to allow extensive competition with foreign makes.

In speaking of developments aiding in winning the war, probably the greatest of all were the developments in repair methods which permitted the use of the damaged German shipping when they were most needed. The one development most in evidence was electric welding of cast iron, etc To this alone is due the transportation of a surprising percentage of our troops to the front. This was distinctly American

(14362) M. A D. asks: 1. What causes the explosive report occurring almost simultaneously with a heavy discharge of lightning? 2 Is a ball of lightning, as often termed, a high positive charge electric spark? 3 Has the voltage of lightning ever been recorded or estimated? A.—1. When the thunder comes almost simultaneously with the flash of lightning the flash is very near you. The sound of thunder travels in the same manner as all other sounds, with a velocity of not far from 1,120 feet per second, or about 5 seconds per mile The usual way to estimate the distance to a flash of lightning is to take the time between the flash and the report, and allow 5 seconds to a mile. The rumbling of thunder is due to reflections from different parts of the cloud. 2. We do not know what ball lightning is. 3. The voltage of a flash of lightning depends upon its length, or the distance of the cloud above the earth. This varies very greatly, from a few feet up to perhaps a half mile.

NEW BOOKS, ETC.

A TEXT-BOOK ON MACHINE DRAWING FOR ELECTRICAL ENGINEERS. By Edward Blythe, A.M.I.Mech.E. London: Cambridge University Press, 1920. 4to.; 61 pp., 48 plates.

The author would extend the same aid to the electrical engineer as many existing texts offer the mechanical engineer. He presents a course in drawing that deals with the constructive details of electrical machinery and apparatus, so that lecture room theory may be reinforced by more practical knowledge. His examples are systematically progressive, through elementary projection to the making and reading of working drawings. The most modern types of apparatus are portrayed, and the whole forms a good introductory treatise on construction.

NOTES ON CHEMICAL RESEARCH. By W. P. Dreaper, O.B E. Philadelphia: P. Blakiston's Son and Company, 1920. 8vo.; 195 pp; portrait.

A second edition of this work has provided opportunity for enlargement. Graduate students will find it a succinct account of the conditions which apply to original investigation, the first part of the book dealing with scientific fact and method, the second with aims and methods, embracing industrial practice and organization The discussion confers a greater ability to "see into things," a realization of the relative importance of observations, and a better judgment of the correctness and value of deductions.

BURGESS BLUE BOOK Compiled by Yorke Burgess. Chicago: The Burgess Company 16mo., 108 pp.; illustrated.

Students and practical men will appreciate the electrical formulas, drawings, problems and calculations contained in this pocket-size instructor. Understandable drawings of shunt, series and compound motors, controllers, auto starters, etc, are interspersed and succeeded by rules, suggestions and information of great value; the properties and capacities of various wires are given, with practical calculations, and dynamos and motors are described and their troubles elucidated

CATALYSIS AND ITS INDUSTRIAL APPLICATIONS. By E. Jobling, M.C. Philadelphia: P Blakiston's Son and Company, 1920. 8vo, 144 pp; illustrated

The second edition of this valuable treatise is almost a new work The acceleration of chemical action by foreign bodies is a fact of which industry is widely availing itself, and the more recent extensions of its use are detailed by the author. Sulfuric acid manufacture and the fixation of atmospheric nitrogen are but two of many applications treated of in this book, which, by its scope and its inclusion of the latest knowledge, commends itself to all students of industrial chemistry.

TERTIUM ORGANUM (The Third Organ of Thought) By P D Ouspensky. Translated from the Russian by Nicholas Bessaraboff and Claude Bragdon. Rochester, N. Y Manas Press, 1920. 8vo; 344 pp., illustrated.

Is Russian thought to be the connecting link between the mysticism of the East and the realism of the West? Ouspensky's fourth dimensional philosophy as set forth in "Tertium Organum" inclines us to this belief. It is perhaps the heaviest gun Idealism has yet fired, but its genius lies, not in the infallibility of its conclusions, but in the projective power of its concepts coupled with an amazing simplicity of expression. It is a search for the means of that "expansion of consciousness" at which all religions aim. It errs, as they err, in insisting upon repudiation of the physical environment as the path to higher development Safe advance comes by a superposition of concepts analogous to the stereoscopic vision, not by immediate supersedure of the old by the new.

SPOT AND ARC WELDING. By H. A. Horner, B A. Philadelphia and London: J B Lippincott Company, 1920. 8vo.; 296 pp; illustrated.

Electric welding has long been successfully used in repair work, but there is a disinclination to trust to this method in new construction "Spot and Arc Welding" seeks to overcome this disinclination The writer believes that the weld may beneficially supersede the rivet. The data of the Emergency Fleet Corporation are given in full, and builders and manufacturers will find here much that may readily be adapted to their particular ends. Machines, operations and results are displayed in numerous clear illustrations, theory receives its full quota of space, and a series of appendices handle material of great interest in plate and pressure work.

IN THIS ISSUE

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8 MAR 1921

THE MOTOR SLED VERSUS THE DOG SLED IN THE FROZEN NORTH.—[See page 85]

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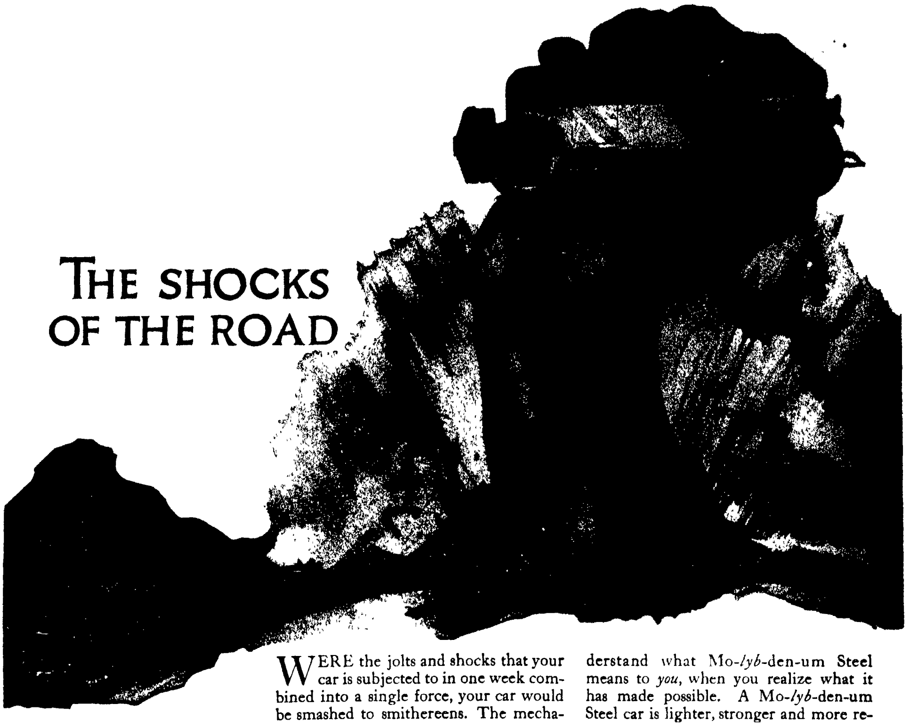

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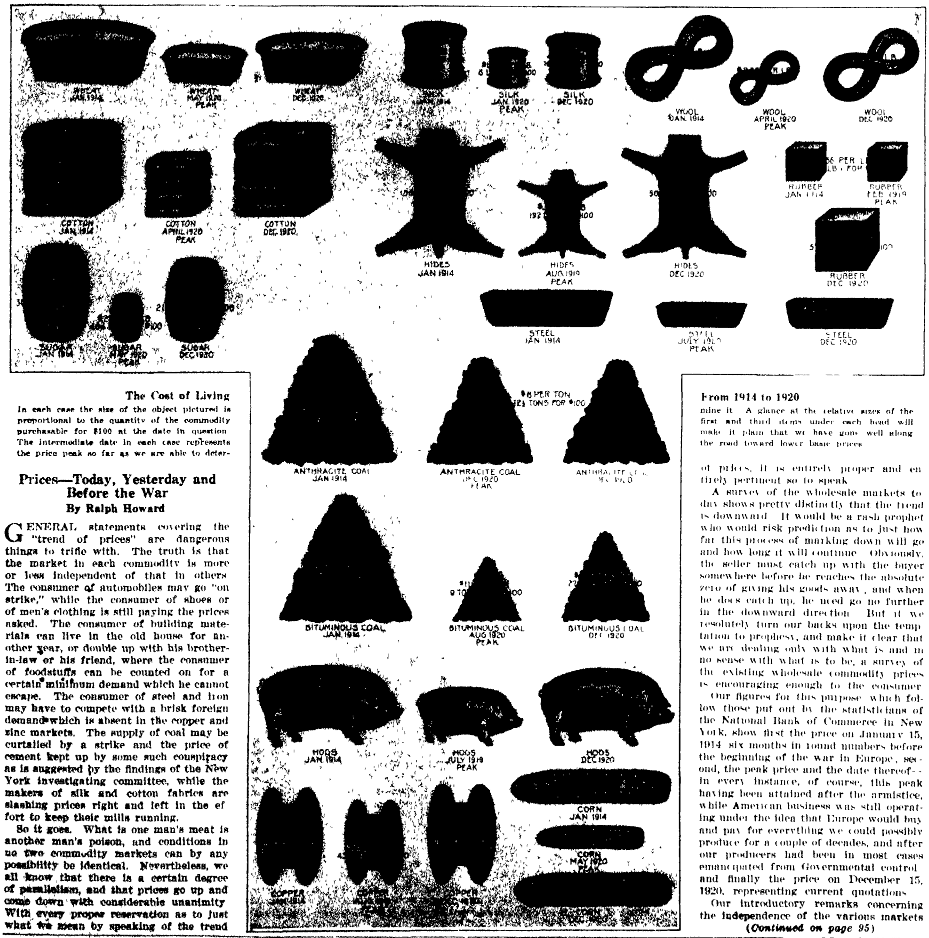

The Cost of Living From 1914 to 1920

In each case the size of the object pictured is proportional to the quantity of the commodity purchasable for $100 at the date in question. The intermediate date in each case represents the price peak so far as we are able to determine it. A glance at the relative sizes of the first and third items under each head will make it plain that we have gone well along the road toward lower basic prices

Prices—Today, Yesterday and Before the War

By Ralph Howard

GENERAL statements covering the "trend of prices" are dangerous things to trifle with. The truth is that the market in each commodity is more or less independent of that in others. The consumer of automobiles may go "on strike," while the consumer of shoes or of men's clothing is still paying the prices asked. The consumer of building materials can live in the old house for another year, or double up with his brother-in-law or his friend, where the consumer of foodstuffs can be counted on for a certain minimum demand which he cannot escape. The consumer of steel and iron may have to compete with a brisk foreign demand which is absent in the copper and zinc markets. The supply of coal may be curtailed by a strike and the price of cement kept up by some such conspiracy as is suggested by the findings of the New York investigating committee, while the makers of silk and cotton fabrics are slashing prices right and left in the effort to keep their mills running.

So it goes. What is one man's meat is another man's poison, and conditions in no two commodity markets can by any possibility be identical. Nevertheless, we all know that there is a certain degree of parallelism, and that prices go up and come down with considerable unanimity. With every proper reservation as to just what we mean by speaking of the trend of prices, it is entirely proper and entirely pertinent so to speak.

A survey of the wholesale markets today shows pretty distinctly that the trend is downward. It would be a rash prophet who would risk prediction as to just how far this process of marking down will go and how long it will continue. Obviously, the seller must catch up with the buyer somewhere before he reaches the absolute zero of giving his goods away, and when he does catch up, he need go no further in the downward direction. But if we resolutely turn our backs upon the temptation to prophesy, and make it clear that we are dealing only with what is and in no sense with what is to be, a survey of the existing wholesale commodity prices is encouraging enough to the consumer.

Our figures for this purpose which follow those put out by the statisticians of the National Bank of Commerce in New York, show first the price on January 15, 1914 six months in round numbers before the beginning of the war in Europe, second, the peak price and the date thereof-- in every instance, of course, this peak having been attained after the armistice, while American business was still operating under the idea that Europe would buy and pay for everything we could possibly produce for a couple of decades, and after our producers had been in most cases emancipated from Governmental control and finally the price on December 15, 1920, representing current quotations.

Our introductory remarks concerning the independence of the various markets

(*Continued on page 95*)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Einstein Award

THE Einstein Judges held their final meeting in this office on January 18th. The four essays which were before the committee at the start of the session were speedily cut to three, and then to two, and after an all-day session the Judges found themselves conscientiously able to agree on one of these as the best. This unanimity is especially gratifying, the more so since it by no means was to be confidently expected, on *a priori* grounds, that it would be possible of attainment. Even the Einstein Editor, who might have been called upon for a final decision but wasn't, can hardly be classed as a dissenter, for with some slight mental reservations in favor of an essay which did not enter the Judges' final discussion at all and which he rather suspects appeals more to his personal taste than to his soundest judgment, he is entirely in accord with the verdict as rendered.

The name and address of the winner appear on the facing page. It would have been a physical possibility to present his essay in this issue, but only at the price of hasty proof-reading, of which we have to do more than enough in the ordinary course of events. We therefore hold it over until next week, when we shall be able to put it before our readers in appropriate dress.

The fact that the prize goes to England will be no surprise to those acquainted with the history of Einstein's theories. The Special Theory, promulgated fifteen years ago, received its fair share of attention from mathematicians all over the world, and is doubtless as well known and as fully appreciated here as elsewhere. But it has never been elevated to a position of any great importance in mathematical theory, simply because of itself, in the absence of its extension to the general case, it deserves little importance. It is merely an interesting bit of abstract speculation.

The General Theory was put out by Einstein in finished form during the war. Owing to the scientific moratorium, his paper, and hence a clear understanding of the new methods and results and the sweeping consequences if the General Theory should prevail, did not attain general circulation outside Germany until some time in 1918 or even later. Had it not been for Eddington it is doubtful that the British astronomers would have realized that the eclipse expeditions were of particular consequence. Therefore at the time of these expeditions, and even as late as the December announcement of the findings, the general body of scientific men in America had not adequately realized the immense distinction between the Special and the General Theories, had not adequately appreciated that the latter led to consequences of any import, and we fear in many cases had not even realized explicitly that the deflection of light and the behavior of Mercury were matters strictly of the General and in no sense of the Special Theory. Certainly when the American newspapers were searching frantically for somebody to interpret to their public the great stir made by the British announcement that Einstein's predictions had been verified, they found no one to do this decently, nor were our magazines much more successful in spite of the greater time they had to devote to the search. In a word, there is not the slightest room for doubt that American science was in large measure caught asleep at the switch—perhaps for no reason within its control, and that American writers were in no such favorable case to write convincingly on the subject as were their British and continental contemporaries.

So it is quite in accord with what might have been expected to find, on opening the identifying envelopes, that not alone the winning essay, but its two most immediate rivals, come from members of that school of British thought which has been in contact with the Einstein theories in their entirety for two years longer than the average American of equal competence. This riper familiarity with the subject was bound to yield riper fruit. Indeed had it not been for the handicap of writing in a strange language, it is reasonable to assume that the scientists of Germany would have made a showing superior to that of either Americans or British—and for the same reason that Britain showed to better advantage than America.

Before leaving the subject, we wish to say here a word of appreciation for the manner in which the Judges have discharged their duties. The reader will have difficulty in realizing what it means to read such a number of essays on such a subject. We have been fortunate beyond all expectation in finding Judges who combine a thorough scientific grasp of the mathematical and physical and philosophical aspects of the matter with an extremely human viewpoint which precludes any possibility of an award to an essay that is not properly a popular discussion, and with a willingness to go to meet each other's opinions that is rare, even among those with less ground for confidence in their own views than these gentlemen have.

New Jersey, the North River and New York

THE phenomenal business growth of Manhattan and the necessity of providing suitable suburban homes for its multitude of workers and carrying them expeditiously to and from their work, presents a problem whose solution becomes increasingly perplexing as the years go by. No sooner is a bridge built or a tunnel opened than it is taxed to the utmost.

Manhattan Island as a residential section has reached its limit. Increasingly the growth of industry and business is driving the homeseeker to the outlying districts. Evidence of this is seen in the fact that the population of Manhattan showed a decrease in the recent census over that of ten years ago. The only outlet is to the north and the east, and this migration coupled with the rapid growth in population has resulted in a congestion of the rapid transit lines of travel to the Bronx and Long Island, which is already very serious and promises to produce in the near future a positive impasse.

The easiest solution of the problem would be to divert this daily tide of travel, or a portion of it, in some other direction. True, but in what direction? If you placed a map of Manhattan and its environs within a radius of twenty-five miles, before some stranger who knew nothing of state divisions, rivalries and politics, he would undoubtedly point to New Jersey and suggest that the obvious thing to do was to divert the tide of travel in that direction and so prevent the threatened deadlock on the lines of transportation to the Bronx and Long Island.

If our suppositititious stranger were an engineer, a specialist in the problem of city transportation, he would point out at once that there are four great bridges and fourteen tunnels connecting Manhattan and Long Island and only six tunnels connecting Manhattan with New Jersey—or forty lines of rail traffic and four vehicle roadways to the east as against only six lines of rail traffic to the west.

To our answer that New York terminated on the shore of the Hudson River he would make the obvious reply that in such a vital matter as this, the accidental or arbitrary location of state and city lines should cut no figure whatsoever, and the problem should be judged absolutely by topographical considerations—in other words, that in planning for the industrial and social convenience of a population of seven million people, their interests should be considered as identical.

Apart from the artificial barrier of imaginary state lines and sectional prejudices there is no obstacle to the uninterrupted flow of traffic between Manhattan and New Jersey. The North River, once looked upon as an insuperable obstacle to unbroken rail and highway connection, has now ceased to be such—thanks to the genius of the civil engineer. It can be crossed by as many bridges and tunnels as we wish to build.

As to the comparative merit of the two systems there can be no question whatever. Compared on a basis of cost for the same traffic capacity, the bridge is by far the cheaper both in first cost and cost of operation—since vehicular traffic involves a very expensive system of ventilation in any tunnel.

There is much public and official misconception on this subject; it is not understood that, as compared with a bridge crossing, crossing by tunnel is a very extravagant method. To be convinced of this, we have but to consider the great North River Bridge which is to be built at Fifty-ninth Street.

On the two decks of this structure, each of which will be 180 feet wide, there will be accommodation for 8 steam railroad tracks, 6 rapid transit tracks and 14 lines of vehicular traffic, seven each way. To accommodate all this in tunnels would call for 18 tunnels. The Canal Street tunnel is to cost $28,000,000. If we allow $22,000,000 per tunnel at present costs, the total would be $400,000,000. Now the North River Bridge at present prices would cost $100,000,000, or only one-fourth as much. Considered on the basis of cost, convenience, comfort and health a bridge is the obvious solution.

When an Invention Is Not an Invention

THERE exists in our patent and copyright laws a gap which has always seemed to us a lamentable one, and one which there is not the slightest justification for leaving unfilled. This has to do with the invention—we use the word though the law denies its propriety—of printed forms for the keeping of accounts or any other purpose.

It goes without saying that much skill and thought may be expended upon the formulation of a set of forms which shall be the last word in furnishing a framework for the proper recording of a certain kind of data. Business of many kinds is dependent upon tabular devices of this sort under one head or another; the invention of such a form may be of great value to its users. It would seem that the man who devotes his time and energy and ingenuity to getting up a thing of the sort ought to be rewarded to the same degree and in the same manner as the man who invents a new safety pin or a novel design for a perfumery bottle or a clever trade mark. But under the law and the decisions as they now stand he is able to get no protection of any description; you or I or anybody else may manufacture and sell his form in direct competition with him and he has no redress save to undersell us.

The hitch lies in the fact that the law defining invention is so worded that a blank form to be filled in by the user is not an invention. It has no mechanical features, and it is not a process or a product. If the inventor be sufficiently ingenious to design it in such fashion that the user has to punch a hole as part of the process of using it, or join two parts of it in a certain predetermined relationship, or fold the left fifth over upon the right fifth and tear them half off and turn one of them over again in order to bring into juxtaposition two parts of the paper that were originally remote, this constitutes the mechanical feature necessary to make the form stand up under fire as an "invention" entitled to patent protection. But in the absence of such a feature the patent examiners will have nothing to do with it, and if the unhappy inventor turns to the copyright division, he learns that whether his device is an invention or not, it certainly is no publication and he cannot protect it by copyright. Even the feeble solace of a design patent seems denied him.

The situation has long been familiar to us. We are inspired to comment on it by a subscriber who shows us a farmers' account book which he has devised. This is an admirable article, and at the same time it fills a want, for the farmer, never an accountant, is required to keep accounts under penalty of paying an income tax on a lot of income that isn't income. But our subscriber can't advertise his little book decently, for if he does some substitute that doesn't have to meet any advertising expense will appear and wipe out his market. We think he has a grievance against the Government that tells him that an invention is sometimes an invention and sometimes isn't.

Electricity

Japan's Electric Lamp Industry.—An estimate of the total output of electric light bulbs in Japan for the year 1920 is given as 14,000,000 pieces. The demand for bulbs for home consumption is increasing and orders are forthcoming from India, China and the islands in the south.

National Electrification in Holland. — On account of the scarcity of coal in Holland, it is proposed to use electricity and to use it economically. The scheme, we learn from the *Electrical Times* of London, provides for the electrification of virtually the whole country, including the industries as well as lighting and railways. It is said that a consumption of 100 kw-hr. per capita is anticipated as compared with from 35 kw-hr. to 40 kw-hr. at present.

A Water Tank Heater for application to water containers provided with pipe outlets has been recently designed by an electric manufacturer This heater fits threaded pipes of 1¼-inch or 2-inch inside diameter. It is inserted through the walls of the vessel below the minimum water level. It is made in various capacities from 500 watts to 4,500 watts, on the standard commercial voltages. The larger sizes have three heats, selected by means of a switch on the heater cord

Resonance Coils for Radio. — Discovery of a new method of sending and receiving radio messages was announced recently by Major-General Geo O. Squier, according to *The Wireless Age*. Through development, it is probable that wireless will be improved so as to permit the confining of messages to the parties directly interested. The discovery came about through investigations made early in the war on the uses of submerged bare wires. Out of it grew what is now known as a "resonance wave coil." Discussing some of the powers of the new invention, the scientists list the following: It is possible to locate an airplane in flight, to tell the direction of the flight, to tell how high it is flying and to tell by the use of two coils and mathematical deductions the distance of the airplane from the wave coils. The instruments can be used as range finders and in the same manner they can be used for airplane finding. Radio messages can be handled from airplanes without the trailing wires now used. Static interference can be reduced

Glass-Covered Meters. — The use of glass-covered meters is increasing, according to *Electrical World*, and many central station men and manufacturers believe that they will be ordered in greater numbers when deliveries become easier Companies which are using these meters find that they facilitate the settlement of complaints, especially when a meter is suspected of creeping Customers prefer a meter that can be seen working. The objections to glass covers have for the most part been overcome. Unevenness of the edge of the cover which might cause a poor fit has been taken care of by a felt gasket, consequently no trouble from this source has been experienced Condensation, which sometimes appears on the inside of the glass, could be present on the inside of metal covers without being noticed upon inspection of the outside

The Superlative in Circuit-Breakers.—The heaviest circuit-breakers ever designed for 13,200-volt service will be installed by an electric light and power company of New York City, in its Hell Gate station There will be 120 of these solenoid-operated circuit-breakers, having an interrupting capacity of 58,000 amperes at the arc, 1,500,000 kva. The disconnecting switches are gang operated and their operating mechanism is interlocked with the oil-breaker mechanism.

Electro-Pneumatic Brakes.—One of the first trains equipped with the three-wire electro-pneumatic brake and telephone system to be operated over any railroad in the world is now in operation over the Tyrone division of the Pennsylvania railroad. The object of the electro-pneumatic brake, so we are told by *Electrical Review*, is to secure a rapid simultaneous application and a graduated or direct release of the brakes on all cars regardless of the length of the train, thus avoiding the objectionable slack action between cars. A turbo-generator situated at the top of the locomotive smoke-box, generates direct current at a pressure of 110 volts for actuating the electric magnets on the air brake valve of each car. When the engineer switches on the current and applies the air brakes, he is enabled to make a quick, smooth and safe stop, and the objectionable slack action between the cars is thereby avoided.

Astronomy

Observations of Faint Variations.—One of the principal pieces of work carried on at the McCormick Observatory of the University of Virginia is the observations of long-period variables which are so faint at minimum (mostly below the 13th magnitude) as to be beyond the reach of observers with telescopes of moderate aperture. The number of such stars now under observation is 187.

Dr. Russell's Medal. — It gives us the greatest pleasure, and a certain amount of pardonable pride, to announce that Prof. Henry Norris Russell of Princeton, for some years the contributor of our monthly astronomical page, has just been awarded the gold medal of the Royal Astronomical Society of London This is by all means the highest honor that can come to any astronomer, for it goes to the man whose work entitles him to be regarded as the foremost astronomer of the world for the year. Dr Russell goes to England late this month to receive the medal at the February meeting of the Society. The particular work in recognition of which the award comes is doubtless the theories of stellar evolution which Dr Russell has been sponsoring for ten years past. At first regarded as entirely too radical, these are now generally accepted, and paved the way for Michelson's extraordinary determination of the diameter of Betelgeuse which Dr Russell himself describes in the SCIENTIFIC AMERICAN MONTHLY for February

Astronomical Telegrams.—The central office for the international exchange of astronomical telegrams was established at the Royal Observatory of Belgium, at Uccle, in 1919, by the International Research Council, and M. Lecointe, director of that observatory, was appointed president of the commission having charge of this work Observatories and similar establishments throughout the world who subscribe to the international telegraphic service pay an annual fee, which is fixed at the beginning of each year and is in no case to exceed 25 francs The money thus raised covers the expense of printing circulars and correspondence Each subscribing institution pays in addition, the cost of all telegrams addressed to it Subscribers are expected to accord to the central bureau priority in the announcement of all discoveries, observations or important calculations, and they are reimbursed for the expense of telegraphing these announcements. Telegrams are sent in cipher The telegraphic address of the central office is "Astra Bruxelles"

THE EINSTEIN AWARD

THE $5,000 prize offered by Mr. Higgins for the best popular essay on the Einstein theories is awarded to the essay submitted under the title "Relativity" and nom de plume "Zodiaque" by Mr. L. Bolton, of London. This essay will appear in the SCIENTIFIC AMERICAN for February 5th, and will be followed in subsequent issues by a number of the other essays of special merit, some in full and others in part.

The Astronomische Gesellschaft.—A note in *Popular Astronomy* describes some of the great contributions made to astronomy by the Astronomische Gesellschaft, of Leipsig, including the recent publication of the first volume of a monumental 8-volume work on variable stars, which has been in preparation since 1901, and well-known earlier works, such as the 19 volumes of the A. G star catalogues, the biographical *Vierteljahrschrift* and *Jahresbericht*, etc The note goes on to say that, owing to financial difficulties, the Gesellschaft will offer its library for sale, including a complete set of the *Astronomische Nachrichten*. We are told that this is an unusual opportunity for some American institution to get a complete bound set of this valuable journal at a very moderate cost, and that the purchaser "will not only get some advantage from the current rate of exchange, but will at the same time assist the Society in its efforts to keep up its present publications." We should like to point out that there is also an "unusual opportunity" for American astronomers to come magnanimously to the aid of the Astronomische Gesellschaft and save that illustrious organization from parting with its library at all!

Industrial Efficiency

The Paris Marche du Monde.*—Due to the support* accorded the Paris Marché du Monde by the various countries, the board of directors have decided to alter their original plans According to a letter received from the director of the American division, the new *plans call for 10 stories instead of 6, and a skyscraper* tower comprising 35 floors This tower will be about 60 feet square and almost 500 feet high, and will be the first of its kind ever erected in Europe It will be devoted to offices for those tenants who do not *wish to display their goods* Particulars can be obtained from Milton L. Schmitt, Director American Division, Paris Marché du Monde, Paris, France

Turf for Fuel. — A new method of drying turf to relieve the serious fuel shortage in Finland has been put into operation in various Scandinavian countries The new method was invented by engineers working under orders from the Russian Soviet Government to find a more labor-saving method of preparing turf as fuel for the great central power station near Moscow, *the process being made known in Finland through an* escaping engineer The fundamental principle of the process is quite simple The raw turf in the swamp, by a powerful jet of water under a pressure of 20 atmospheres, is freed from all old roots and changed to *thin mud This is pumped out on a drying field and* spread in layers When sufficiently dry it is cut into bricks of uniform size by means of a tractor The turf pump is constructed like an ordinary water turbine is reversible with aid of electric motor, is equipped with *a cutting apparatus which completes* the work of the water jet, and can be raised or lowered as the surface of the mud varies The entire equipment is mounted on a car which can be pushed forward or backward on rails along the line of work

New Tanning Process from Australian Shrub.—A shrub growing principally in the gold fields of Australia has been found to possess properties suitable for tanning purposes, according to recent reports *Leather tanned by the extracts from this* shrub is adjudged equal to the best, being especially useful in lining hats Some excellent samples of fast dyes have also been extracted from this shrub An ex*tensive area has been granted the new en*terprise by the West Australian minister of mines, over which the company will strip the bush to feed a tanning and extracting works

Encouraging Emigration. — Canadian government representatives have caused a boom in Wales as the result of the emigration campaign Lectures have been enthusiastically attended by crowds of both sexes, *and as a result* many farm laborers, domestics and miners, among them many ex-service men, are desirous of leaving immediately for Canada Nova Scotia asked for 500 miners, the number who offered themselves far exceeded this, *and the first parties have left for* their new homes All are ex-soldiers and receive free passages for themselves and their families

The Shark Industry on the Pacific Coast is reported as having developed into an established profession Shark fishermen are still making good money, and are also making records in big creatures caught The sharks are what is known as of the "mud" variety, ground feeders at great depth and entirely harmless to human beings They live in great numbers in the deep inlets of the coast and are valuable for their livers, their skins and the fertilization values of their flesh and bones At Main Island, on the coast near Vancouver Island, the shark fishermen are catching very large mud sharks at a depth of 100 and 125 feet Some of the sharks caught have been 35 feet long

Argentina's New Paper Pulp Industry has been inaugurated with the opening of the first paper pulp factory last September The mill, which is located near Barranqueras, on the Parana River, is using as raw products a species of bog grass called "paja brava" This grass grows during the whole year, and is so abundant in the swampy places that it has been considered a nuisance At present the mill is equipped to make only a pulp in sheets and strawboard for paper boxes It has a capacity of three tons of strawboard per day The construction of the mill was begun over two years ago during the war There is undoubtedly a good field for a more elaborate wood-pulp mill in the north of Argentina, since an abundance of trees and plants suitable for paper making exists in that region and there is a market for the product in Argentina

Left In order to save concrete cinders are being used to fill the space up to within a few inches of the steel *Right* The bay at the lock site ready for forms

Two phases of the work on the New Orleans canal

The Mississippi's Mouth

What New Orleans Is Doing to Insure Its Permanent Navigability

By J. F. Springer

THE Mississippi River is a combination of an asset and a liability This is particularly the case at New Orleans Without it, the city would perhaps never have arisen It serves to put this commercial center upon the sea coast and make of it one of the leading American ports At the same time, the river is occasionally unruly It flows in a great arc past the city at an elevation twenty feet above it, and thus becomes a perpetual menace But New Orleans has never been submerged This freedom has been secured through the use of energy and intelligence

In the past few years, New Orleans has attracted attention by the determined effort put forth to extend and develop her facilities as a great port The new and gigantic repositories for the wharf storage of cotton and the big grain elevator lately constructed are examples But everything is naturally subordinate to the matter of water connections with the Gulf of Mexico The natural thing to do is to maintain an open and safe passage through one or more of the distributaries of the great river Another is to connect with the Gulf by a waterway through Lake Pontchartrain

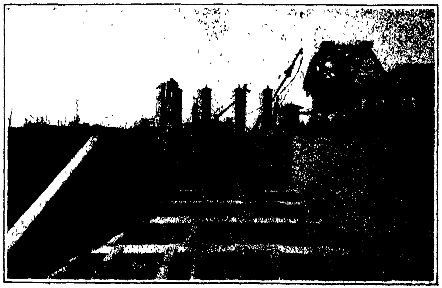
The problem of maintaining a passage through an outlet of the river has been agitated for two centuries There is no difficulty at all presented by the stretch of river extending ninety miles downstream from the city There is plenty of water both horizontally and vertically There are three principal outlets from the end of this stretch One of these Pass a l'Outre, has at the moment no claim of interest The South Pass is the shortest, but smallest of all, and has been in great use for two score of years Southwest Pass is a splendid natural waterway except at its terminals where it is obstructed It was this route that Eads first proposition concerned But Congress insisted upon South Pass and so the great jetties were constructed there The maintenance of this waterway has been successful though somewhat expensive It now affords a channel 32 feet deep But there is a natural advance of the bar due to settlement of sediment This has been assisted, as we are told by A E Washburn, by mud-lump formation The result is that the approach for ships coming in from the Gulf has been shifted far to the east and has created a difficult turn at the mouth of the jetties The current maintained and directed by the jetties is, of course, opposed by the body of deep water presented by the Gulf This stemming of the flood, as it were, serves to form the bar whose crest is now about 2,000 feet from the jetties On the Gulf side, the slope is exceedingly gentle, being only about 1 in 100 The bar is steadily advancing at a rate of perhaps 75 feet per year and will ultimately obstruct or divert the mouth of the outlet itself There is doubt whether South Pass could, at a reasonable cost, be sufficiently developed and indefinitely maintained Attention has been directed toward the development of Southwest Pass

Actual construction in connection with this route began fifteen or sixteen years ago The work has been going on since, but the proposed 1,000-foot channel 35 feet deep has not yet been developed Formidable difficulties have been encountered Thus, in the jetty construction at the mouth of the pass, the natural currents in the Gulf are not so favorable as are those at the mouth of South Pass. At times, it has been difficult or impossible to secure sufficient support for the heavy weights that it was desired to impose upon the bottom The foundation could not be depended upon to maintain its support What are called "sand waves" have greatly interfered with the development of Southwest Pass A sand wave is a formation due to the rapid rush and deposition of a large body of sand Several hundred thousand cubic yards of material may be involved A shifting of 150 feet in a 24-hour day has been observed A shoaling up amounting to 20 feet has also been noted as occurring in the same length of time A "mud lump" is an "exudation of soft clay, caused by the weight of the new sediment which is deposited during the river floods" They frequently occur right in the channel itself Outside of the channel mud lumps may attain considerable heights. Thus, they may rise to levels 9 or 10 feet above the river surface Equilibrium will eventually take place because of the increasing weight of a developing mud-lump The levels named, however, show how far the process may go before a balance is attained.

New Orleans is, however, not content with the developments of South and Southwest Passes, but is rapidly putting through a canal scheme The Inner Harbor-Navigation Canal will connect the Mississippi River and Lake Pontchartrain by a waterway 5 miles (28,000 feet) long This canal passes through the city itself When the Board of Commissioners of the Port of New Orleans have completed this great undertaking, there will be in the city ocean docks fronting on deep and quiet water subject to a very small tidal fluctuation. On the river front it has been found practically impossible to maintain piers projecting at right angles to the current of the river, because of the rapid sedimentation of the small basins thus created Ships have to lie alongside wharves parallel to the river or stand out in the stream The new additions to harbor facilities will provide very still water The water level in the lake varies 6 feet, while that in the river varies 19 feet, both from the same minimum The canal level, except at the river end, will vary with that of the lake To effect a junction with the river, a big lock is being constructed. The canal depth will be 30 feet At the bottom, the width will be 150 and at the top 330 feet The lock is to be long enough to receive a vessel 640 feet in length and it will have a width of 75 feet Four lift bridges will enable the canal to be crossed at as many points One of these is located at the lock and is, in fact, carried by the lock's substructure Then there is the big siphon which provides a passage for one of the principal drainage outlets of the city The lock begins at the terminus of a 2,000-foot section of the canal located at the river end It forms part of the line of the canal The canal section next the river will naturally be subject to the floods of the stream. It is accordingly necessary to continue the river levees along both sides of this part of the canal. These are to have heights of 23 feet above low water. There will thus be a margin of 4 feet between the river level in this part of the canal and the top of the earthen wall. Briefly, the canal will consist of a 2,000-foot stretch forming a side projection of the river and a 25,000-foot arm of the lake, with a short intervening transition section.

The land in all this region consists of river silt; so that the usual problems of rock excavation do not require solution here. But a novel situation arose because of the fact that the route runs through an old swamp forest. Beneath the root mat of this forest are the stumps of another and older one. From the surface to a level 15 feet below, the stratum consists of an intermingling of stumps and

(*Continued on page 97*)



Details of the siphon that provides a passage past the canal for the city's drainage. In the background are seen the gate valves and one of the canal bridges

New York's Snow-Fighting Tractor Plows

By Alfred Longville

DURING the month of February, 1920, traffic tie-ups due to unexpected blizzards cost the merchants of New York City some sixty million dollars, and the city itself five and one-half million dollars for emergency snow-removal work Although the Department of Street Cleaning did everything that could be expected of them, their equipment was inadequate to handle the situation, and outside contractors were called in *These contractors failed the Department at the critical time.*

Horse-drawn snow plows and motor trucks were of limited use only against the deep snow drifts None of the equipment owned by the Department, or available outside, was able to handle the heavy fall and packed snow, except a few small tank-type tractors which had been voluntarily offered for the work. Tractors of this type were found equal to the task

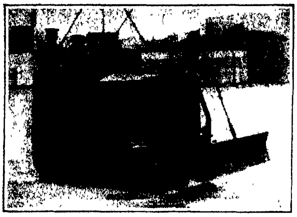
The Department of Street Cleaning has maintained in the past, and still does, an Engineering Bureau which tries out and tests all kinds of street-cleaning appliances. After the costly experience of last winter, the city officials and business men of New York concluded that the city could not again afford to be snowed under *and that special measures were necessary*

A Snow-Removal Committee was appointed by Mayor John F. Hylan with Fire Chief John Kenlon as chairman This committee was to report to the Mayor on ways and means of handling the snow in the most efficient manner. Chief Kenlon, basing his plans upon successful fire-fighting experience, decided that it was imperative to have motor equipment which could be kept at work throughout the storms so that it would be necessary to clean up but a small part of the snow when the storm was over

The Snow-Removal Committee, working on this basis, organized a series of tests during the month of July All manufacturers of track laying tractors were required to compete in this event, a committee having already decided that the track-laying type was the only type able to handle the snow under extreme blizzard conditions. Sand was spread thickly on the pavement in the place of snow and the tractors equipped with push plows *were required to demonstrate their* ability to work under "blizzard" conditions

From the results of this demonstration and investigation, the specifications for the machines were written The Committee on Snow-Removal having accomplished its purpose, it was superseded by a committee for the purchase of snow removal equipment, headed by Mr Grover A. Whalen as chairman Mr Whalen is also chairman of the Board of Purchase, and Commissioner of the Department of Plants and Structures This committee decided on the purchase of one hundred small tank-type tractors, fifty large crawler type tractors, and a big fleet of trucks with dump bodies, together with the necessary push plows for the tractors The one hundred small tank-type tractors are equipped with winter tracks, a covered cab, a two man seat, storm curtains and sirens One of the small tank type tractors appears in the illustration at the top of this page The powerful engine of this tractor, together with the heavy tractor belt provided with special cleats for work in snow and on ice, insures proper operation of the adjustable push plow

Last winter, during the blizzard which not only tied up New York but many other cities, the small tank-type tractor had many opportunities to prove its ability to keep roads and streets clear when all ordinary methods failed, and no doubt there are many municipalities still using horse-drawn equipment on snow plows and scrapers, which will follow New York's lead and install automotive equipment to solve their snow-cleaning problems For New York's decision was based upon successful performance under the worst conditions experienced in many years and upon severe tests which have substantiated this performance in every way



Small tank-type snow plow adopted by New York City for cleaning its streets during blizzards

The motor sled can cross a narrow chasm or brook by means of felled trees, because of its powerful tractor belt

Testing the Horner motor sled under actual conditions, showing the location of the driver's seat and the driving wheels and traction belts

The Motor Sled Versus the Dog Sled

By George Gaulois

LITTLE is required by way of introduction to this story. Of late the newspapers have devoted sufficient front page space to the experiences of our three Naval balloonists in the frozen wilderness of northern Canada to give us all a pretty fair idea of what traveling means in snow-bound lands The slow and laborious trip of Lieutenants Kloor, Hinton and Farrell from Moose Factory to Mattice, with their snow shoes and *dog sleds cannot fail to impress us* with the stern necessity for better means of travel over snow

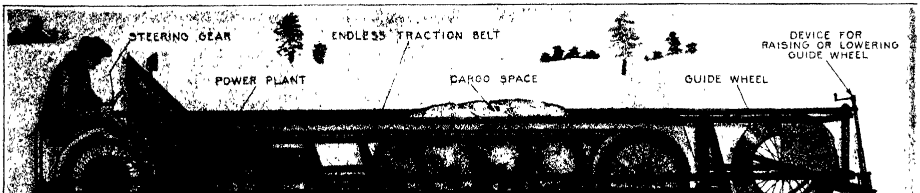
Long before the above-mentioned incident. Frank G Horner of Ruby, Alaska, set to work developing a suitable motor sled that would take the place of the primitive dog sled First-hand experience with the many difficulties incidental to traveling over soft snow and broken ice, as well as in exhaustive engineering study of the problem, led to his development of the motor sled which forms the subject of our present cover illustration In the words of Horner, his object has been to provide a motor sled which may be used for transporting goods and passengers over the snow, especially in those northern countries where traveling is done largely in winter by means of dog sleds

As will be noted in the drawing below, the Horner motor sled has a frame consisting of the top members which extend from the front to the rear of the machine on each side This frame is preferably composed of hickory wood Beneath the upper members are longitudinal frame members which terminate short of the top members, as indicated Midway between top and bottom of the sled and on each side are longitudinal frame members Then there are brace members disposed along the sides of the sled and inclined to the rear, the purpose being to provide a construction which will take up the thrust encountered by the runners without danger of so racking the sled as to cause it to break to pieces Another interesting feature is that certain members are connected to each other by means of rawhide tongs, for the reason that the inventor has found by experience that this form of connection is preferable to a rigid construction The latter, if it is made of metal, tends to crystallize and will eventually break

So much for the main frame Secured to the bottom of the struts or brace members are the runners, which, it will be noted, do not run the full length of the machine The *forward and rear ends of each runner are* curved upwardly Each runner is provided with a central longitudinal groove and between the groove and the edge is a metal shoe

A pair of driving wheels are mounted at the rear of the sled Toward the front of the machine is a pair of idler wheels A pneumatic tire is applied on each wheel, but the tire in this instance is somewhat out of the ordinary, in that it is thicker and has a flat outer surface which is grooved Arranged to extend over each drive wheel and its corresponding idler is an endless belt which is made preferably of steel tempered so as to pass around the wheels without being permanently set or bent Secured to one side of this belt is a series of cleats

The motor sled is so constructed that it is not damaged by coming into contact with rocks or logs or other obstructions Furthermore, being somewhat like the caterpillar tractor in its method of locomotion, it can cross narrow chasms, *brooks and other declivities* alone or with the aid of felled trees, as shown in one of our illustrations



Details of the Horner motor sled which has been developed with the idea of encountering all conditions of snow travel and replacing the present dog sled

Power in Big Packages

Some of the Economies to which We May Look Forward if We Pool Our Fuel-Burning Plants

By S. G. Roberts

LAST June we printed an article dealing with the economic possibilities of the superpower plan proposed for a section of the northeast Atlantic seaboard. Subsequently, Congress made available $125,000 to be used under the direction of the U. S. Geological Survey in carrying on certain investigations preliminary to the adoption of the scheme as originally outlined by William S. Murray; and private interests of various sorts have patriotically contributed to promote the thoroughness of the studies in hand. After something like nine months of active inquiry and the co-ordination of a wealth of data, Mr. Murray and his associates of the superpower survey have reached positive conclusions of the utmost value, which we present in this article.—THE EDITOR.

A YEAR back, the estimates presented by Mr William S Murray, originator of the superpower zone project, startling as they were, as evidence of prevailing wastefulness, were conservative, but the figures arrived at in the meantime reveal more than ever why it is well-nigh imperative that the superpower zone become a fact at the earliest practicable day It is indisputably plain that great benefits can be reaped by the pooling of electrical energy through the inter-linking of an array of highly efficient central stations And it is equally clear that the isolated plant is no longer to be encouraged unless it is of a character that will warrant its operation as a unit in the superpower equipment

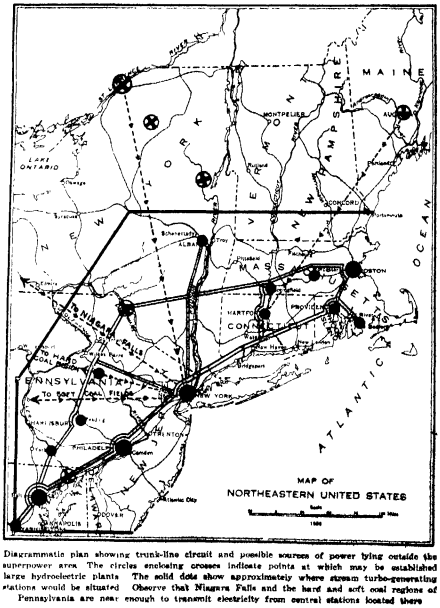
The scope of the superpower zone has been somewhat amplified since the inception of the project The present boundaries include the southern sections of New Hampshire and Vermont, and more of New York, Pennsylvania, Maryland, Delaware and New Jersey than at first contemplated Pretentious as this sounds, the land area involved is only two per cent of that of all our states Within this region lives 22 per cent of our population, and these people, with a little more than a third of the nation's developed mechanical energy at their command, produce in value 40 per cent of our manufactured articles This is interesting inasmuch as we see that this section of the country may quite properly be compared industrially with the British Isles which, also, are really a vast finishing shop and draw from elsewhere the bulk of their needful raw materials

The American worker has hitherto held his own in competition with the cheaper labor of Europe by reason of the automatic apparatus and the machine tools put at his disposal; and probably nothing illustrates this more strikingly than the difference in horsepower back of the wage earner in this country and in the United Kingdom Here, taking the worker at large, he has had to help him 2 6 horsepower as against 1 5 horsepower of his British fellow A decade back the corresponding value of the products per wage earner per annum was $2,950 for the American and $1,800 for the Britisher Again, limiting the comparison to the workers living within the contemplated superpower zone, the native wage earner has had 4 horsepower to aid him in turning out his wares, and the value of his products has been $3,700 in the course of a twelvemonth.

Simple arithmetic shows how vital to our industrial well-being is an ample supply of motive energy and if we are to be in a position to compete in the markets of the world it is imperative that we continue to furnish our army of labor with as much horsepower per capita as in the past, if not more But we cannot do this and maintain the same economic lead unless we make it feasible to develop the power at a lower cost That is to say, do here just what so many of the leading nations of Europe are taking radical steps to accomplish through a wider application of electricity and the generation of current along the most approved lines

Our electric utilities in the superpower district burn, commonly, only a little less than 3 pounds of coal per kilowatt hour, and the power plants of isolated manufacturing establishments consume on an average 8 pounds per kilowatt hour—some of them actually squandering 18 pounds The fuel for this service is, for the most part, moved from the mines to the points of use by the steam railways, and an analysis of their operation brings out the fact that these common carriers, for the equivalent of a kilowatt hour, make away with something like 7½ pounds of coal We have substantially 9,000 locomotives threading the rails inside of the section under discussion and because of the fuel needs of these engines, fully 18½ per cent of the tonnage hauled by them brings in no financial return One of the purposes of the superpower plan is to relieve the railways of this incubus The means to this end will be the complete electrification of one-fifth of the 30,000 single-track miles of trunk line roads. The density of traffic on the remaining 24,000 miles is not yet sufficient to warrant supplanting the existing steam traction

In the year gone our mines yielded a total of 646,000,000 tons of both bituminous and anthracite coal, and we should bear in mind that one-third of the coal burned in the United States is consumed within the so-called superpower area This gives us some idea of the extent of the coal traffic which, in this region, amounts to two-fifths of the entire tonnage. To go on at the same rate with the existing transportational means would surely occasion the utmost confusion a few years hence. We get a hint of what might happen from some of the figures lately offered by the experts of the superpower survey. It seems that the estimated traffic of all sorts between 1920 and 1930 will increase from 170,000,000,000 ton-miles to 310,000,000,000 ton-miles for the entire district.



Diagrammatic plan showing trunk-line circuit and possible sources of power lying outside the superpower area The circles enclosing crosses indicate points at which may be established large hydroelectric plants The solid dots show approximately where steam turbo-generating stations would be situated Observe that Niagara Falls and the hard and soft coal regions of Pennsylvania are near enough to transmit electricity from central stations located there

The super-power zone as now planned

Today the roads for which electrification is advocated use three-fourths of the coal burned by the various railways within the limits of the superpower zone, and the desire is to augment the service of these dominating trunk lines and yet effect this by materially cutting down their fuel consumption That is to say, the lines that should be electrified handle at present 14,000,000,000 ton-miles, and ten years hence they would be expected to take care of 175,000,000,000 ton-miles, such being the burden industrial expansion would lay upon them. The present power station capacity of the electrified divisions aggregates 120,000 kilowatts, and by 1930, if the electrification scheme be adopted, the total central station capacity will be augmented to 1,370,000 kilowatts. Inasmuch as the improved central stations will be able to develop a kilowatt hour for 1 7 pounds of coal, and can distribute within a radius of 150 miles from the source of generation large blocks of energy at a loss of only 5 per cent, there is little reason for wonderment in the claim of the technicists that it will be possible at the start to reduce the annual consumption of coal in the superpower zone by 80,000,000 tons, if not more.

One impressive revelation, following the investigations of the experts of the superpower survey, is the large measure of time that existing power installations are either idle or running at a low percentage of their capacities. They represent heavy initial outlays, an immense sum taking them in the aggregate, and they constitute an overhead that must be allowed for in the distribution of profits and losses. Theoretically, this equipment should be run continually and thus pay promptly for the initial cost, and thereafter, so long as fit, become a source of revenue This, unfortunately, is far from being the case; and the worst of the wasters are the power plants of isolated manufacturing establishments. From the data at hand, it seems that out of a year of 300 working days, for example, the prime movers are operating only 18 per cent of the time However, if the energy needed by these factories, mills, shops, etc, were furnished by the superpower system, the generators of the latter could be run at full load for sixty per cent of the period mentioned.

This arrangement would stimulate tremendously the output of commodities, bring in a handsome return upon the power installations, and actually provide a far bigger volume of motive energy while burning annually less fuel by millions of tons. Taking the superpower zone in its entirety, the present total power consumption is approximately 27,000,000,000 kilowatt hours, and, if the normal rate of traffic and industrial expansion continue, the energy demand in 1930 would amount to 50,000,000,000 kilowatt hours. With the superpower zone system in action, nine years hence the interlinked electrical trunk lines should be able to take care of three-fourths of this stupendous load. Our central stations now meet an energy demand of 12,000,000,000 kilowatt hours, and by 1930 they should be equal to an energy demand of

(Continued on page 97)

A Matter of Definition

Divergent Viewpoints as to What Constitutes a "Popular" Essay

By the Einstein Editor

ARISTOTLE it was, to the best of our halting recollection, who first pointed out that all argument rdeuces to disagreement over definitions. If we could but agree as to precisely what it is that we are talking about, and precisely what we mean by every statement we make about it, there would be little room for contradictory opinions as to the truth or falsity of these statements. If we may revert to the terms of our recent geometrical discussion, it stands to reason that argument must be mainly confined to the question of what we shall assume to be true; once having set up and agreed upon a categorical set of assumptions, it is indeed a rare case where the consequences do not follow with sufficient definiteness and certainty to preclude controversy. There is then nothing left to argue about.

This point is strongly driven home by examination of the essays submitted in competition for the Einstein prize. When a man competes for a sum of this size, it may be taken for granted that the product of his pen represents his best conception of the thing asked for When he discusses to the extent of 3,000 words such a subject as the Einstein theories, without committing any material offense against scientific accuracy, he has presented good evidence that he is a person whose opinion is of some weight. Yet between the various contestants who submitted scientifically competent essays there existed a disagreement as to what constitutes a popular essay, so wide as to inspire us to the present discussion.

We must after all define the essay by defining the audience. Just how much scientific knowledge are we to assume on the part of "the lay reader," "the person with no special mathematical training," "the normal man of intelligence," etc.? This very question, one of our contestants reminds us in his introductory paragraph, was put to no less an authority than Faraday, just prior to one of his public lectures, and the great populariser of science replied decisively "None at all." If Faraday were with us today, he might find it desirable still to answer the question in the same way. But times have changed greatly in a century, and we seriously doubt that he would take so extreme a viewpoint.

WE ARE not going to apologize for the Einstein award—we make this bald statement lest the article on this page look like an effort to do this. We are sure that when it appears next week, the winning essay will silence all critics who await it with the suspicion that it is not going to be properly populai We are not even going to apologize for some few of the essays which, in recognition of their intrinsic merit, we shall later print in spite of the fact that they are not in all respects what we feel that a popular essay should be On this page we are merely stating an academic question, suggested by the contest, which seems to us one of interest; and answering it in a manner which seems to us reasonable, and which we hope will seem to our readers interesting.—THE EINSTEIN EDITOR

What Does a "Layman" Know?

Faraday lectured to earnest young men who were using his talks as a means of making a first acquaintance with scientific matters. In the absence of the funds and the social standing necessary to see them safely into one of the universities, public lectures of the sort he delivered were the only means of instruction in science open to these aspirants Under such conditions, Faraday was necessarily talking to men who knew nothing of science; that was why they were there before him. But today, with our enormous press, our vast system of public libraries, our processes of ordinary education so much more general and so much more effective than a century ago, our procedure whereby anyone can have a higher education who wants it enough to work for it, we have created a reading public with a degree of general scientific background never before approached In attempting to meet the scientific curiosity of the layman we no longer need feel obliged to go all the way back to the beginning to meet him; we may be assured that he can come part way to meet us.

In the mind of anyone who has ever given instruction of any sort, in any place, there will inevitably here arise the uneasy query: "Yes, he can. But will he?" In any group of students there will always be a certain proportion whose attitude is a puzzle. For some years I have been teaching mathematics in the evening courses at Columbia. With due exceptions, the student body in these courses is composed of men and women who work during the day, and who are taking advantage of the opportunity to get a college or an engineering education at night. Necessarily this means that for the eight months of the college year there is practically no leisure; life is a continuous round of work and college. It would seem as though these were conditions calculated to freeze out every student who was not in deadly earnest. Yet in every class one finds a few students who come night after night without the least preparation, who never so far as appears make the slightest effort to assimilate the instruction put before them by the text and the instructor—who display an outlook upon the work of the course which seems the height of absurdity in one who goes to school at such great inconvenience

Empty Buckets and Empty Heads

I think the answer lies in a failure of the immature mind to comprehend just what instruction consists in I am rather well convinced that it is not through deliberate design that the student assigns to himself a rôle analogous to that played by the bucket in the drawing of a gallon of water, but that it is through sheer non-comprehension of the necessities in the case that he looks to the instructor to pour knowledge into his unresisting but unassisting mind Of course it cannot be done that way; but the student in many cases never discovers this And much of the reading of "popular" articles on science and other serious topics which I see impresses me as being done in this very state of mind The reader would be highly indignant if we were to characterize him as illiterate, but this in effect is what he is He has acquired a trick of following the printed word with his eye while closing his mind to its implications and above all to its demands. If we hit him over the head with a rhetorical black-jack, if we drive home a point with sledgehammer force behind a happy phrase, he will perhaps take in what we say, if we demand the least degree of independent exertion on his part he will slide gayly over the surface and report that he has been quite unable to make out what we are talking about And no writer can make every sentence a sledge hammer, nor could any reader stand up under the repeated concussion if it were possible for the writer to sustain this pitch

Perhaps, then, we have made progress Perhaps we may agree that the popular essay is aimed at the reader who will contribute his bit to its intelligent reading Then we have to define our audience by agreeing just how much it may fairly be asked to contribute Just what equipment of scientific ideas and of specific scientific knowledge may we fairly demand of—well, let us say of a man who, by his desire to know what the Einstein theories are about, implicitly claims the ability to take up this information

We may profitably bear down upon this question from the negative side first, and narrow the issue by stating a few of the things which it is not fair to demand

We must before all else beware of presenting to this man material which not alone is he unequipped to take in, but which it would be unreasonable to expect that he would ever equip himself to take in. There are certain lengths to which we can profitably go in search of new knowledge, and others to which we individually cannot with profit go. If you insist on having it, you may get training in automobile construction which will qualify you to take your car completely apart and put it together again. But at less exertion you can learn everything you need in connection with anything that is ever likely to happen to you on the road. You will profitably leave complete knowledge of automobile assembly to the man whose business it is to assemble automobiles. In any event, if you try to duplicate his knowledge, you will find that it takes a lot of time—probably more time than you have to give.

Beginning at the Beginning

In the realm of science the situation is the same I have a certain knowledge of mathematical analysis and the foundations of mathematical theory, acquired at the cost of some six years of close attention to these things in undergraduate and graduate work I do not deny to any person of normal intelligence and proper willingness the ability to duplicate this knowledge But is it unreasonable for me to feel that if it took me six years to gain whatever mastery of the subject is mine, the next fellow may fairly be asked to spend as long in covering the same ground? Am I not justified in feeling that certain items, representing largely the climax to which the work of six years has led, are of such a complex and special nature that it is rather hopeless for me to attempt to tell you anything about them until you have followed me through the prerequisites?

Do not misunderstand me I would not support the notion that science is a hereditary oligarchy, to which only the elect may aspire I would not stand at the door of science and deny admission to anyone, I would merely make him show his ticket, or, if he had none, go and get one And it would be necessary for me to take this stand, because offense here comes from both sides The over ambitious writer attempts to put before his popular audience things which are fundamentally unfitted for that audience in its present state or in any state it can soon acquire, and, on the other hand, the over ambitious layman demands to be informed about this, that and the other thing which he has not the foundation for understanding To a gentleman who recently questioned my statement that there really were things which the lack of preparation of a layman prevented us from presenting to him, I suggested the differential equation as a sample of this sort of thing I never saw an effort to explain to a layman what such an equation means, and I have no idea that such an attempt would ever succeed Before we can talk a language we must acquire the vocabulary And it disgusts me excessively when a man to whom geometry is such a closed book that he has not the slightest notion what I mean when I speak of proportion asks to be told what a sine or a cosine is I can tell him what trigonometry is about, what it does and to a considerable extent how it does it; but he will have to go back to school before I will undertake to mention a sine in his presence

Most people I find are inclined to be reasonable about this sort of thing. When they are not so inclined they must have reason forced upon them And the success of a popular essay on any scientific subject depends in very large measure upon the degree of judgment shown by the author in deciding just how far he may safely go into his subject He has got to go far enough to make it seem worth while, he must not go further than his audience is equipped to follow him

Ideas and Their Labels

Much the same remarks may be made with regard to the actual language employed as to the matter covered The simplest thing can be talked about with sufficient polysyllabic profundity—or perhaps pseudo-profundity—to make it unintelligible When we attempt to define the vocabulary of the "average reader," however, we encounter far greater difficulties than when we try to delimit his scientific horizon But there is one point on which I have the strongest feelings Names are made to use Every word in the language, from the simplest to the most technical jaw-breaker of them all, exists because it represents a thing or an idea which, in the absence of this word, would have to be named at greater length than is necessary when we have the word, or perhaps even described in considerable detail On meeting a new person the first thing we learn is his name; and unless we be one of those exasperating folk who can go through an introduction with all the outward manifestations of correct form but without paying the least attention to the other fellow's name, we at once proceed to employ that name in speaking to or of him Before the introduction it was the tall, handsome gentleman in the brown

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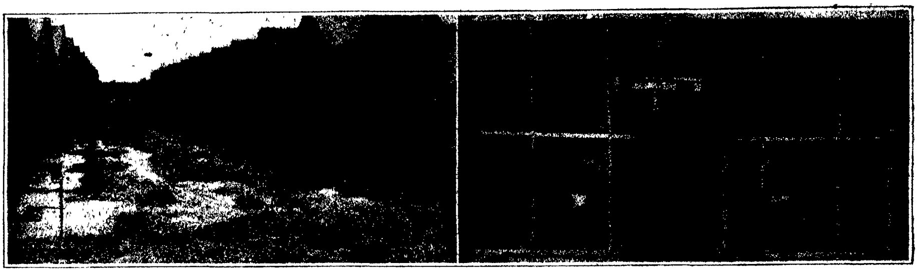


Left: Carbon black "burning" buildings showing gas mains and connections. *Right:* Interior view of a burning building in which air-cooled scrapers are used instead of the channel-iron variety

Inside and outside the buildings in which natural gas is burned into carbon black

Where the Printer Gets His Ink

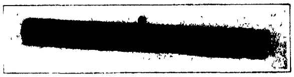
America's Carbon-Black Industry and the Methods It Employs

By Henry P. Westcott

CARBON black is a pure, flocculent form of carbon which is manufactured from natural gas. It is made by burning gas under very low pressure in a low flame with not enough air admitted to produce complete combustion. The result is that the unconsumed carbon is deposited on a roller or plate, from which it is removed by an automatic system of scrapers and conveyors. Carbon black is then bolted or sifted and is packed by special machinery. It is a most curious substance, for when first scraped from the plates it is so light that 30 pounds of it are sufficient to fill a sugar barrel; the specific gravity of carbon black, however, is about 1.7, so that it is really very much heavier than water; therefore, 95 per cent of the bulk of black as it comes from the plates is really air, and the problem of packing is to separate the black from the air so far as is commercially feasible.

The first carbon black was made and sold in this country in the year 1864 for use in the manufacture of printing ink. The original process, which seems to have been invented by J. K. Wright, was applied to artificial gas. The process was satisfactory but the cost of the product was too great. The growth of publications in the United States required an abundant source of carbon black so that ink could be produced at a moderate cost. Natural gas furnished an ideal solution of the problem and carbon black is now made on a large scale from natural gas in West Virginia and other states and is a staple commodity which is used in the manufacture of printers' ink, automobile tires, paints for metals, for carbon paper, typewriter ribbons, phonograph records, tarpaulins, carriage cloth, block leather paper, bookbinders' boards, shoe polish, stove polish, electrical compositions, in cameras, and in making crayons. This is certainly a very diversified use for a primary product. There are, however, two other blacks which also have their uses, but are expensive. We are referring to what is known as "lamp black," which is made by burning tar oils or creosote. Another form of black is made from the burning of the bones of animals. This is called "bone black."

Carbon black, or any black possessing the same properties or adapted to the same variety of uses, cannot be commercially manufactured from any other material than natural gas, artificial illuminating gas being out of the question as a commercial operation on account of the low yield and the prohibitive cost. Of course, the great use of carbon black is in the manufacture of printers' ink, but its use in rubber tires is also enormous. It conserves rubber by lengthening the life of the tire.



The natural gas is burned at tips quite similar to those used in house-lighting

The main point to consider in locating a plant, outside of the proximity to the supply of natural gas and railroad facilities, is to locate it in a depression or gully where it will be least affected by the prevailing winds.

The burning of the gas requires a certain amount of draft, but the flames must be protected from all unnecessary drafts and especially from high winds, otherwise the losses would be entirely too large. Carbon black is very light and under the most ideal conditions a large percentage is carried off by the burnt gases and is lost.

A carbon black plant generally consists of twenty to thirty "burning" buildings, a bolting and packing building, power plant and necessary warehouse for storage of the finished product.

The capacity of a thirty-building plant is dependent upon the constituents in the gas, as the greater the percentage of heavy hydrocarbons in the gas the greater the yield of carbon from 1,000 cubic feet of gas. At one thirty-building plant the writer visited the production was approximately 4,500 pounds per day. This plant was burning natural gas of about 0.61 specific gravity, hence very low in heavy hydrocarbons. This plant consumed during the twenty-four hours about five million cubic feet of gas and made one pound of carbon from 1,100 to 1,200 cubic feet of gas.

In West Virginia the production of carbon from a similar sized plant with much heavier gas—.76 specific gravity—would run over 6,000 pounds per day from the same amount of gas. In other words, with gas of this gravity it would require from 750 to 800 cubic feet of gas to make one pound of carbon black.

The burning buildings are constructed entirely of

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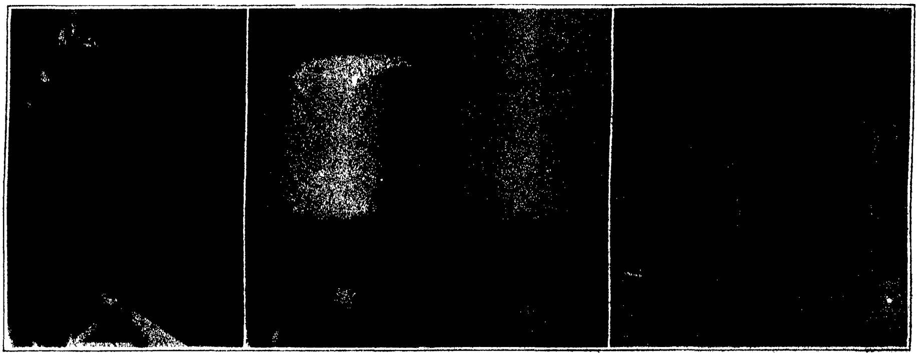


Left: A general view inside the building where the burning is carried on. This view, dim as it is, is quite realistic. *Center:* The blockers, or sifters. *Right:* The automatic packer

Some of the apparatus of the carbon-black industry, which furnishes this ingredient to makers of printers' ink

A Brake for Every Wheel

IN the matter of improved brake design for automobiles, it appears that European manufacturers have little to learn from us just now. If anything, they are showing us the way to more efficient braking. The latest improvement abroad takes the form of a brake construction for all four wheels, replacing the usual type of brakes for rear wheels only, used in most automobiles.

However, an American inventor has recently come forward with a new and simplified four-wheel brake construction on which he has obtained basic patents in the United States An accident while driving showed this inventor the dangers of skidding, and careful investigation led him to believe that the usual brakes are at the wrong end of the automobile.

It has been found in tests that a car equipped with a four-wheel brake system of the general design shown in the accompanying illustration was able to stop in the following distances:

At 10 miles per hour, in 3 feet.
At 20 miles per hour, in 9 feet.
At 30 miles per hour, in 20 feet

With the same type of car equipped with the usual type of brakes it required a space of 83 feet to stop the car at a speed of 30 miles per hour, or almost four and a half times the distance required with the same car equipped with four wheel brakes

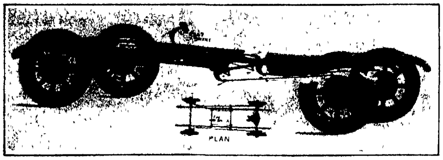
In recent experimental brake tests by competent engineers it has been demonstrated that a touring car with all seats occupied carries the greatest load over the rear axle At the instant when the brakes on the rear axle are applied the load is transferred to the front axle, due to the reaction of the brakes on the rear brake drums This is said to be the principal cause of skidding. With the brakes applied at the same time on both front and rear axles, the tendency to skid is said to be entirely overcome, and a much quicker stop can be made. Traveling over a wet pavement at a speed of 20 miles per hour, the four-wheel-brake car can be stopped within its own length It can round corners at faster speeds than are usually considered safe with wet pavements, because of the excellent control In congested city traffic the four-wheel brakes make the handling of the car an easy matter.

This system of four-wheel brakes can be applied to any standard car with but few changes and in a short space of time

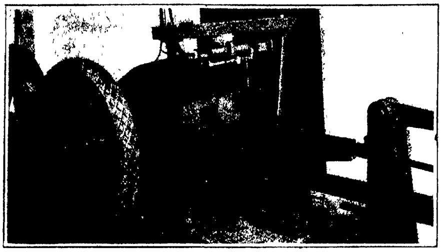
Tire Tolls on the Car Engine

A SPEED limit of 20 or 25 miles an hour may obtain on the National highways, but the maximum speed of 50 miles an hour—the limitation of the apparatus itself—alone governs the operation of special equipment installed by the Rubber Section of the Bureau of Standards, for determining the power loss or energy absorbed by varying types of automobile tires. The conditions of travel to which automobile equipment is subjected in actual use are duplicated in this government laboratory where electrical absorption dynamometers are being applied in a new rôle of usefulness.

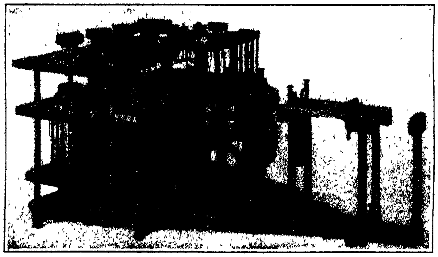
The set of dynamometers, as installed for testing automobile tires, consists of a motor element which carries on its shaft the tire to be tested, and a generator element carrying a drum which is driven by the tire. The arrangement is such that any desired pressure may be exerted by the tire against the drum, any specified speed measured in revolutions per minute or their equivalent in miles covered every 60 minutes may be secured, and the tractive effort or driving force exerted by the tire on the road surface may be varied and controlled by the operator. The capacity of the dynamometers is 20 horsepower when operating at a speed of 50 miles an hour.



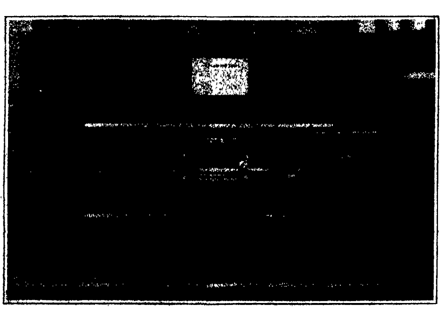
Numerous advantages are claimed for this four-wheel brake system which may be applied to any automobile. Operation of the foot brake applies all four brakes because of the "S" shaped levers, which also take up slack



Apparatus for determining the power loss of automobile tires, or the energy dissipated in heat. This equipment is also adaptable in studying the effect of the fillers on the life of pneumatic tires



Precision resistance bridge with oil immersion, the temperature of which is automatically maintained constant. This bridge measures resistances from .0001 to 10,000 ohms with one-thousandth per cent accuracy



Simple mechanism which controls the locking of a door from a distance by an electric circuit. A powerful spring in the center box unlocks the door and swings it open

The object of the laboratory experiments is to measure the power loss or energy dissipated in heat Likewise, the special apparatus is adaptable in studying the effect of "tire fillers" on the life of pneumatic tires, and on the power absorbed by tires thus filled as compared with that consumed when inflated with air The relative merits of each will be determined according to scientific conclusions based on the results of comparative tests

Where the Ohm Comes From

BATHING beaches are extremely popular and summer resorts are prosperous amid the seasonal influx, but you would hardly think of an electrical testing apparatus operating most advantageously in an oil bath And yet one of the novel features of a new precision resistance bridge designed and constructed by the U S Bureau of Standards functions in oil the temperature of which is automatically maintained constant

Electrical resistance standards as tested for Uncle Sam, State governments, public service commissions, corporations, manufacturers and even individuals, require accuracy from very low to extremely high values ranging from one-ten thousandths of an ohm to 10,000 ohms An essential feature of the duties of the electrical resistance laboratory of the Bureau of Standards is the maintenance of the unit of resistance, one of the fundamental units upon which measurement of electrical power is based Hence the construction of this novel resistance bridge which is capable of making measurements with a degree of accuracy of one part in 100,000 or to one thousandth per cent

The apparatus can be used as a simple wheatstone bridge for resistance of one ohm and above or as a double bridge for resistances below one ohm The bridge is operated in oil the temperature being automatically kept constant Apparatus for testing of electrical resistance standards, in order to insure best results, requires a mechanism of special design and constructed of the choicest material Consequently, both the resistance bridge and galvanometer were designed and built by the Bureau of Standards for the specific work to which the units have been dedicated

Something New in Electric Door Openers

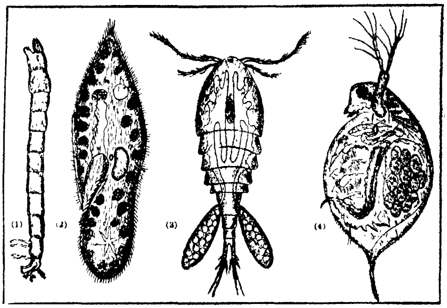
FROM France comes the unique electric door opener which forms the subject of the accompanying illustration This device serves not only the same function as the usual electric door lock, which releases the lock upon the pressing of a button at a distance, but it also swings the door open Its installation is simple, as will be noted What is more but less obvious at first glance, is that the mechanism is such that it does not readily get out of order

In brief the new electric door opener comprises three main members, viz., the lock proper, the electric mechanism and a chain connecting the lock and the mechanism together, as well as the mechanism with the anchor on the frame of the door Normally, the tongue of the lock is held closed in the usual manner A helical spring in the little box mounted in the center of the door is prevented from pulling back the tongue of the lock by an engaging lever However, when electric current, controlled by a push button or other desirable means flows through a pair of electromagnets mounted in the little box, the engaging lever is attracted and swings out of engagement with the rod under spring tension, thus operating the lock and, by virtue of a powerful helical spring, causes the door to swing open The device is automatically reset when the door is swung closed again

Are We Abusing Our Water Resources?

Current Methods of Disposing of Organic and Mill Wastes, and Their Bearing on the Food Question

By P. W. Claassen



1 Bloodworm 2. Paramoecium These creatures, 3/4 and 1/50 inch long respectively, thrive in water polluted by organic wastes The bloodworm forms excellent fish food, and through it waste may be made ultimately beneficial to fish life 3 Cyclops 4 Daphnia. These measure less than 1/10 inch in length, 100 to 200 of them make a good meal for a fish, but they occur only in fresh water and pure water

Four of the small creatures on which food fish thrive, and their relations to water pollution

> *WITH the increase of urban population and the changes, still too embryonic in character to be clearly defined, which are coming over our agriculture, the problem of food production is an ever-pressing one. What means shall we adopt to insure that enough food for all may still be supplied by the ever-decreasing proportion of our population that devotes itself to this business? Dr. Claassen points out that eighty per cent of the world's surface is covered by water, and that if we would only treat it right, this water would be the source of supply of a collection of food products that stand high in the scale of economy, by virtue of the minimum amount of labor required to make them available* — THE EDITOR.

FOUR-FIFTHS of the earth's surface is covered with water and one-fifth constitutes wet or dry land It is safe to say that less than one-half of all the land is being utilized in the production of food and other necessities of life, so that we are dependent, largely, for our sustenance upon the products derived from one tenth of the earth's surface

Our cities are becoming more and more densely populated and the question of providing this great number of human beings with the necessaries of life becomes greater each day Agriculture has advanced so rapidly that today we are literally raising two potatoes where one grew before, and due to the study of animal industry our cows are yielding two quarts of milk where they yielded one before But whereas we have doubled and trebled the products of the land we have done nothing to improve the culture of water life We have given all our attention to agriculture and not only neglected and ignored aquiculture but we have grossly abused the fresh waters from which a great part of our sustenance should be derived

We all like the water as a recreational center and fishing is one of our chief sports during the summer, but it seems that we imagined that the fish "just grew" in the streams regardless of how the waters were being abused Most of us, however, have discovered that the fishing in many of the streams is not as good as it used to be People have concluded that such streams have been "fished out" and have not given the question much further thought What then are the reasons that so many of our favorite fishing grounds have lost their attractiveness to the fisherman? Is it because the fish have all been taken out and the streams thus made barren? This is so only in part The principal reason why our fresh waters are so bare of fish life is because we have looked upon our streams, not as a source of food supply, but as the public sewers which Nature has provided for man's convenience The best site for a town is that near a stream, and a city must be built on a large river or lake The purpose of the river is to furnish water to the city and to carry off the sewage Such an arrangement seems practical and saves installing costly plants for the disposition of the sewage, it was only when our cities became so numerous that a number of them sprang up along the same river that the question of sewage disposal plants arose There are, however even today, many cities which still discharge their sewage directly into the streams Troy, for example, discharges its domestic sewage untreated into the Hudson, and Albany, a few miles below, takes the water and distributes it to its thousands of inhabitants.

Where sewage disposal plants have been installed they have been put in operation mainly for the purpose of making the water farther down safe for drinking purposes and with no thought whatsoever of the effect that the sewage might have upon the aquatic life—the animals and plants of the river. Just how harmful domestic sewage is to fish life we cannot definitely say. Some organic wastes actually benefit the waters but, on the whole, the sewage probably causes a great deal more harm than good and is very detrimental to all the aquatic organisms.

Again not only have we depended upon our streams to carry away the domestic sewage but nearly all our factories of one form or another have been built close to streams so that the water might carry off the waste products which could not be utilized, or by-products which were not produced in large enough quantities to make their reclamation profitable. Many a clear bubbling brook has been changed by the addition of wastes into a black unsightly and obnoxious stream with its rock bottom all covered by a slimy, sticky ooze Where such gross pollution has occurred the fishermen know the folly of trying to catch any fish; but many a man has wondered why the fish did not "bite" when the stream seemed perfectly clear and normal. A small amount of sulfuric acid or sodium cyanide discharged into a stream, accidentally or otherwise, may not alter the general appearance of the water and yet it may kill every fish, insect and plant in the entire stream Once a stream has been depleted of its plants and animals it takes months and even years to bring it back to normal again even though no further pollutions occur

One can hardly point out a stream in the Eastern States which does not have from one to a dozen or more factories or industrial plants situated on its banks. The wastes produced are of various kinds: acids, salts, lime, sawdust, waste from tanneries, paper mills, acid and alcohol factories, dairy plants and others Most of these wastes, whether organic or inorganic, are detrimental to all the living organisms which normally occur in fresh water, annually killing millions of fishes both large and small Not only are the fishes killed, but also the

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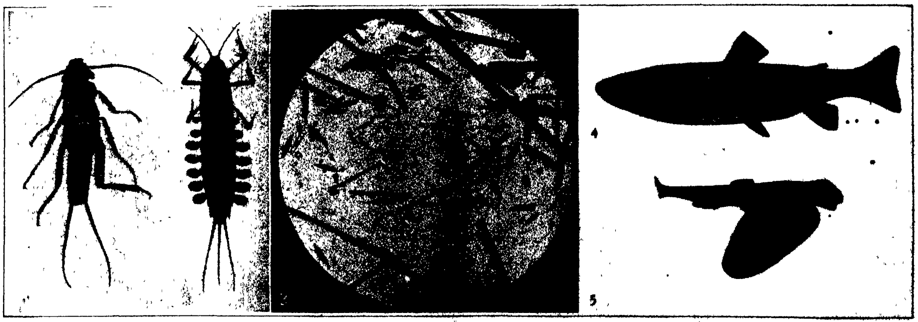
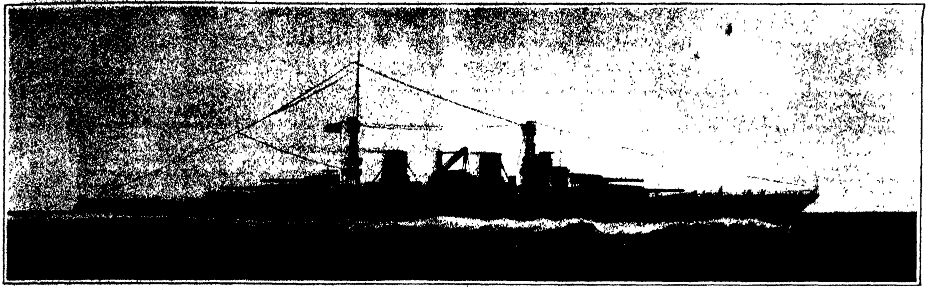


1. A stonefly 2. A Mayfly. These insects, which constitute the food of trout and other fish, are very sensitive to contaminated water and are quickly killed by it. 3. Drop of water highly magnified to show the microscopic plants on which such creatures as stonefly and Mayfly in turn feed. 4. Brook trout, a game fish which must have clean water; it cannot live in contaminated streams 5 Baby trout, at a stage when it is very frail and liable to be killed by a minute quantity of poisonous material

Three stages of fresh-water life, each of which furnishes food for the higher form, and the last for man; all are highly sensitive to contaminated waters



Length: 874 ft. *Beam:* 101½ ft. *Displacement:* 43,500 tons. *Officers and Men:* 1,500. *Horsepower:* 180,000. *Speed* 33¼ knots. *Battery:* Eight 16-in., 50-cal., sixteen 6-in., 53-cal., four 3-in anti-aircraft, four submerged and four above-water 21-in. torpedo tubes. *Armor* Outer belt and inclined interior—thickness not made public

United States Battle-Cruiser "Constellation"—class of six ships

Most Powerful Coast Defense Gun Yet Built

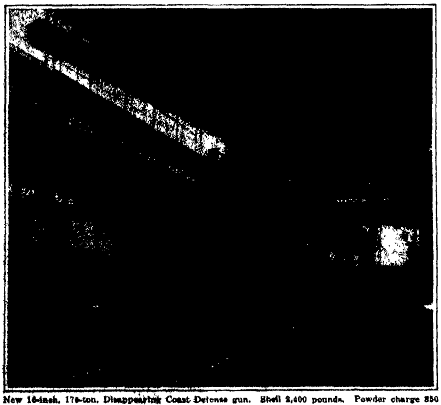
THE largest and most powerful coast defense gun in the world has just been completed at a United States Government Arsenal near Boston, Mass This weapon is a 16-inch high-power gun mounted on a Disappearing Carriage, especially designed for seacoast defense purposes. The gun weighs 170 tons, while the carriage upon which it is mounted weighs an additional 670 tons. The picture shows this enormous weapon and its carriage. When emplaced in the seacoast fortification, the gun and carriage will be behind an embankment of sand and concrete of such great thickness that the highest power naval guns will not be able to penetrate it. This embankment will reach nearly to the height of the gun, so that when the latter is fired only the muzzle can be seen. When fired, the shock of discharge, acting along the axis of the bore, drives the gun into the loading position which is 12 feet below the position of the gun shown in the photograph. A slit which is clearly shown in the photograph, is provided in the armor to allow the gun to recoil back and down to this lower position

The great energy of recoil is absorbed in a number of different ways. Some of it is absorbed in forcing the gun down into its loading position, which raises a huge counterweight weighing 818 tons, 9¼ feet. This counterweight is also used to raise the gun back into its original firing position above the parapet. The remainder of the energy of recoil is absorbed in large hydraulic cylinders located on the carriage. The carriage is also provided with a number of hydraulic dash pot systems, so that in going from one position to another, the energy is gradually absorbed in such a way that there is no shock to the carriage.

For sighting, the carriage is provided with a periscopic sight, similar to that used for submarines, which may be seen in the picture projecting through the armor. This sight allows the gunner to lay the piece upon the hostile vessel without exposing himself above the parapet. Although the gun and carriage weigh 840 tons, they can be easily turned in direction by the power exerted by one man applied at the traversing hand wheel. In other words, the gunner looking through the sight can, by turning a small hand wheel, move the gun and carriage in direction and accurately place it upon the target. The carriage is also provided with electric motors and hydraulic speed gears, which allow the gun to be turned in direction by power under the control of the gun pointer.

One other interesting feature about this type of carriage is the fact that the elevation of the piece can be accurately laid off while the gun is in the recoiled position behind and below the parapet. The rate of fire of this enormous piece of ordnance will be a little better than one shot per minute. The heaviest armor-piercing projectile used with this gun weighs 2,400 pounds and gives a range of over twenty-two miles. The powder charge for the gun consists of 850 pounds of smokeless powder. The projectile has sufficient power to penetrate any armor which can be placed upon the largest naval vessels and at any range. One direct hit with this piece of ordnance would probably disable and might completely wreck a dreadnaught

The light armor plate shown in the picture protects the gun crew from small shell fragments, stones and débris which might fall about the gun if enemy shells should strike the parapet The armor is also of sufficient thickness to protect the crew operating the piece from machine guns mounted in airplanes A crew of about 125 men are required to operate, load and fire the piece.



New 16-inch, 178-ton, Disappearing Coast Defense gun. Shell 2,400 pounds. Powder charge 850 pounds. Muzzle velocity 2,700 f.s. Muzzle energy 121,430 foot-tons

The most powerful coast defense gun yet built

New Road Projected in Ecuador

IT is intended to construct a road in Ecuador from the port of Emeralds in the direction of Quito to connect with a road already constructed from that city to the town of Santo Domingo de los Colorados, making the shortest route of communication between Quito and the coast The principal object of the road is to make accessible about 1,000,000 acres of fertile lands covered with virgin forests, generally level, and situated about 2,000 feet above sea level, thus having a good climate The concession of the lands is very liberal and secures to the constructors of the road the right to something like 500,000 acres of the lands The toll concession is also liberal, and the waterpower sites add to the value of the scheme. By reason of shortness the route will dominate passenger and freight traffic into and out of the interior, and will doubtless attract tourists

New Battle-Cruiser "Constellation"

By J. Bernard Walker

THE wash drawing of the new United States battle cruiser "Constellation" which we present has been prepared from an official sketch received from the Navy Department It will be agreed that this great ship, when it is completed, will be as handsome as any naval vessel afloat It is some five years since the design for the ships of this class was first made public, and it must be admitted that improvements which have been made during that interval have resulted in the ship's having a contour and general relationship and proportion of parts which leaves nothing to be desired The substitution of two big funnels for the original five funnels and the spacing of these funnels and the masts is very pleasing Also, the placing of the four turrets well in from the stem and stern of the ship is conducive to good appearance, and will be favorable to an easy motion of these ships in a seaway

Speaking generally, "Constellation" carries our minds back to the battlecruiser "Hood," although the characteristic clipper bow and the cage masts will make a sufficient difference in the silhouette to readily differentiate the one from the other The "Constellation" is a larger ship by some 2,000 tons She is 14 feet longer and has about a foot and a half more beam Her speed is greater by about a knot and a half, and in her main battery she carries the 16-inch gun, as against the "Hood's" 15-inch

The principal dimensions of the "Constellation" are as follows length between perpendiculars, 850 feet, length overall, 874 feet, beam on load water line, 101 feet 8 inches, extreme breadth, 105 feet 5 inches, mean draft, 31 feet, and normal displacement, 43,500 tons The armament consists of eight 16 inch, 50-caliber guns carried in four 2-gun turrets, and sixteen 6-inch, 53-caliber guns mounted in casemates on the spar deck and in the open on the boat deck There are also four 3-inch, 50-caliber anti-aircraft and four 6-pounder saluting guns The torpedo armament is heavy, consisting of four submerged and four above water 21-inch torpedo tubes

As originally designed, on a displacement of 35,000 tons, these ships were to develop 35 knots, with 180,000 horsepower Steam was to have been supplied by 24 water tube boilers, but so great were the demands for space for the combined steam and electric machinery, that only twelve of the boilers could be accommodated below the protective deck, and the other twelve were placed on the deck above To have placed all the boilers below deck would have brought the outer boilers too near to the skin plating of the ship, and would have exposed them to destruction and flooding by torpedo attack Opinion both inside and outside of the Navy was against the perilous practice of placing boilers above the protective deck, and in the ships as redesigned the beam has been increased from 90 to 105½ feet, the number of boilers has been

(*Continued on page 100*)

With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

The Question of Industrial Housing

THE most general application of the industrial housing principle has been worked out in the cotton mill villages of the Southern States. In the beginning, these villages were established through sheer necessity of finding some place for the mill workers to live. Little attention was paid to architecture, surroundings or sanitation. The houses were usually plain and the villages themselves were lacking in attractiveness

So much for the past But a great change has come about in the last generation It has been generally realized by employers that, other things being equal, the better the village the better would be the class of workers Desirable homes mean less floating of population and less of costly labor turnover

Industrial housing problems develop along two main lines, namely, making over existing buildings, and putting up new buildings In most instances the problem is a combination of both The village of Winnsboro, S C, in which the workers of the Winnsboro Mills are housed, is an example of recent construction The village itself is situated on high land, in a healthful location and with excellent drainage The houses are of substantial frame construction, with five or six rooms, all on one floor Each house has excellent plumbing, toilet facilities, and heating arrangements A supply of good water is provided. Pasturage for cows is available

Other features of this village are an attractive school, a dispensary with operating room and a nurses' house where children may be left in the care of a trained nurse while their parents are working Winnsboro is a new village, built from the ground up, so to speak

Then there is Hogansville, Ga, which is a case of making over an existing village, where the Hogansville Mills of the International Cotton Mills are located This was an ordinary mill village with rather more than its share of dirt and discontent The industrial housing engineers in charge of this work began by painting Then they fixed up the standing houses in good shape and built many new ones Plenty of room was left for gardens and lawns Trees and shrubbery were planted, streets were graded, sidewalks laid, water and sewer systems installed, and all wires were placed underground Extensive playgrounds were made, with a swimming pool, over which is now being constructed a community house with auditorium, social and class rooms, bowling alley and other features Today Hogansville is a joy to the eye Better still, workers like to live there and they take pride in their homes and their town It is a real community

The largest housing operations ever undertaken in this country were in connection with war industries of various kinds A majority were of temporary construction, but a number of permanent towns and villages were built with almost the speed of temporary work

Space only permits the mention of a typical wartime undertaking The Yorkship Village, which is probably the largest permanent housing operation constructed in the United States and is in many respects the most notable, is our example When the Government's great program of shipbuilding was begun early in 1918, the facilities of the New York Shipbuilding Company were greatly increased and thousands of employees were added. To house these employees Yorkship Village was planned It is located near the company's yards, on the outskirts of Camden, N J

Ground was first broken on the site of Yorkship Village on May 20, 1918 Before March 1 of the following year, 907 houses were ready for occupancy Another three months saw 1 386 houses, a hotel and 56 apartments completed Streets have been paved, sidewalks laid, lawns graded and trees have been planted Yorkship today is an attractive, complete village, equipped to house approximately 10,000 persons

The problem of housing the workers is a big one—and one that requires the attention of industrial housing specialists Fortunately, there are engineers who specialize in just such problems, and who are always ready to plan and execute plans for housing anywhere from a dozen to ten thousand workers and their families.

The Rôle of the Portable Belt Conveyor

THE handling of materials in quantities for comparatively short distances cannot longer be undertaken by outworn wheelbarrow methods Even ignoring the cost of these methods, the present labor shortage makes such an extravagance of human effort practically impossible Although portable conveyors have been used for handling bulk materials under various conditions for many years, such machines have been heavy, crude affairs In fact, heretofore no serious study has been given to the proper design and manufacture of these conveyors, or to the development of their logical markets

But the time has come when the portable belt conveyor is really practical and even necessary Almost daily new uses for these conveyors are being developed It is simply a new tool offered the industrial world, and the latter is only beginning to learn how to use it. Among the numerous applications which have recently been found for the portable belt conveyor are

1 Unloading cars. This is the most general use and probably the most important It applies to box cars, dump cars, gondolas, in some cases with shoveling and sometimes with most of the shoveling eliminated. 2 Loading cars from stock piles, factories, pits, warehouses and so on 3 Piling coal, especially in making emergency storage piles It can also be used for moving coal about in large storage piles so as to prevent deterioration 4. Reclaiming from storage in manufacturing plants, delivering to fixed conveyors or other machines 5 Piling bags and boxes in warehouses 6 Removing overburden from pits or quarries, delivering material back into the pit 7. Fueling steamers from barges or docks 8. Loading wagons and trucks from piles or bins 9 Feeding stoker magazines from bins 10. Handling excavations from basements

In general, the portable belt conveyor can handle all materials in bulk or package These conveyors are handling coal in all sizes from slack to large lumps, as well as other materials of the same physical characteristics and in the same range of sizes As for operating costs, these are not of great consequence One or two kilowatts of electrical energy, costing 2 to 10 cents per hour, drives a short conveyor, and three to five kilowatts, a long conveyor. Belts wear from one to three years according to service

Electric Cranes in the Leather Industry

THE cost of handling hides in the beam house and tan yard became too large an item in the production cost of a Newark, N J, leather company, so the use of an overhead electric crane for the purpose was given thorough consideration As a result, a 2½-ton leather-handling crane was installed, and it has been operating for close on to three years with excellent results

The frames carry from 50 to 60 hides each, as a result, the output of the plant has increased from 300 hides daily to 500 hides daily Previous to the installation of the crane, 40 to 45 men were employed in the beam house and tan yard, but now 12 men are putting through 50 per cent more hides than the 40-odd men were capable of doing Based on a reduction in the working force of 30 men at $25 a week each, minimum wage, a saving of well over $30,000 per year in labor cost is realized, which is equivalent to the interest on $500,000 at 6 per cent

These many advantages, which are being brought to the attention of the leather industry, are bound to cause the widespread utilization of electric cranes in the not distant future

How Much Electric Current for Heating?

LARGE industrial plants and factories find electric air heaters useful in heating crane cabs, outhouses, valve, pump and meter houses, exposed remote corners or rooms, watch or signal towers, for shearmen and tablemen in steel plants, in theater ticket booths, as well as for scores of miscellaneous applications Flexible electric conductors will carry electric heat cheaply and efficiently to the most inaccessible points.

As a rule, best results will be obtained by installing several small electric heaters, as they are easy to handle and can be arranged in various combinations to suit the space available, while temperature regulation is readily obtained by a simple arrangement of knife switches permitting any number of units to be cut in or out of circuit

Anyone may readily figure the amount of electric current necessary for heating a given space Here are the thumb rules:

A—.35 watt per cubic foot. This takes care of the heat required for raising the temperature of the air approximately one complete change of air per hour For more frequent changes, increase the wattage proportionately.

B.—Plus 3.5 watts per square foot of wall area. This takes care of the loss of heat through the walls In figuring the wall area, the area of the four sides of the rooms and the ceiling and the floor are all included and a deduction is made for the glass area This rule assumes good building construction, such as a good 12-inch brick wall or a well-made double frame wall.

C.—Plus 35. watts per square foot of glass area. For measuring glass area, the overall area of the frame is measured and this area is deducted from the total wall area.

The foregoing procedure assumes a temperature elevation of 70 degrees, or, in other words, external temperature of zero, room temperature of 70 degrees. If the room adjoins other heated rooms, allowance must be made, based on the difference in temperature between the room under consideration and the adjoining room.

Where a satisfactory steam or hot water system is in use, or where the architect has calculated the steam or hot water requirements, these can be translated into electrical capacity very simply

One square foot of radiating surface using low pressure steam is equivalent to 70 watts One square foot of radiating surface using hot water is equivalent to 44 watts. Therefore, if a heating system is in satisfactory use with a radiating surface of 100 square feet, it would require a heater of 100 x 70 or 7,000 watts capacity, if steam. and 100 x 44 or 4,400 watts if hot water

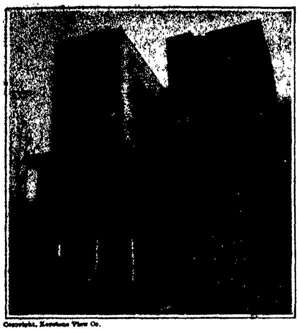
It should be noted that the thumb rules given determine the heater capacity or watt rating required, which is quite a different thing from determining the average amount of heat or current required, or the total consumption during the heating season, as the heater would not be expected to operate at full capacity all the time, but would operate most of the time at a reduced capacity and cut off part of the time

Speaking of Reclamation

RECLAIMING and utilizing scrap material has been impressed on the railways by war conditions, and at the recent annual meeting of the American Railway Engineering Association it was shown that many railways have erected special reclamation shops.

A reclamation plant established by the Rock Island Lines at Silvas, Ill., has a scrap dock 48 ft. wide and 1,500 ft long, with six bins 28 x 42 ft. for storing unsorted scrap, eight bins, 28 x 30 ft, for sorting scrap, and 74 bins of various sizes for sorted scrap. Three traveling gantry cranes of 4 and 10 tons capacity have lifting magnets for 1,500 and 8,500 lb. loads A shop 25 x 270 ft. contains a 100-lb. hammer, two 150-lb power hammers, double and single alligator shears, bolt shear, rattler for cleaning, drill press, nut tapping machine, four electric welders, four oxygen welding outfits, air-operated shear, and air-operated punch.

This plant is doing such work as welding cast-iron spokes on driving wheels, building up worn spots on firebox castings with acetylene welding; mating and repairing flange-worn steel-tired wheels before turning, thereby saving a great deal of labor; reclaiming salt deposits from refrigerator cars for use in thawing switches during the winter, and for use in fire barrels; pressing oil from waste (one barrel of waste netting about 20 gal. of oil); burning the waste and reclaiming about 50 lb. of babbitt, reclaiming barbed wire for use in building rip-rap.



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A foundation as tall as the house itself has made this apartment house possible

An Apartment House Built on Stilts To Fit Its Site

WHILE there is nothing new in building a house on the slope of a steep hill, it is equally true that the apartment house shown in the accompanying view is an exceptionally daring case of building on a steep slope.

A New York property owner had a parcel of land facing the Hudson River This parcel of land, following the regrading of the street, lay 30 feet below the street level at the front or street end and some 120 feet below the street level at the extreme rear No better site could be found for an apartment house, because of the splendid and unobstructed view of the river. So the parcel of land was utilized for a lofty apartment house, by means of a huge foundation which is higher than the house itself The backyard of the apartment house, which is a double house, by the way, is supported by tall steel pillars, as shown.

Another Try at the Safety Poison Bottle

WITH the death-toll due to accidental poisoning always before us, it is little wonder that so many attempts are constantly being made with a view to making poison bottles as safe as possible Some of these attempts are extremely ingenious, and the range is all the way from bottles with the prickly sides of the porcupine, to bottles with radium labels.

At the recent Chemists' Exhibition held in London there were exhibited a number of novel bottles for the prevention of accidental poisoning. Several of these are shown in the accompanying illustration. One of the bottles, it will be noted, is so made that it will not stand in an upright position, therefore it is almost impossible to mistake it for another bottle in the dark Two of the bottles—the tall ones on either side of the picture—are provided with a lock and key arrangement for the stopper The fourth bottle has a cup-shaped top which precludes mistaking it for a conventional bottle,

Speeding Up the Perforating of Grease Cellar Plates

AN interesting method of perforating the plates used in connection with grease cellars in locomotive driving boxes is being employed by the Norfolk and Western Railway at their shops in Roanoke, Virginia. The largest plates are 18 inches wide and the standard lengths are 8 feet.

The sheets of metal are placed on a guideway and entered between the feed rolls to which is attached an arm with an adjustable rod. This rod controls the movement of the sheet into the punch at the opening stroke. The punch consists of four rows of punches Thirty-two punches in each row punch 128 holes 3/16 inch in diameter with every stroke of the machine. In order to break the load the punches are varied in length.

The punch die consists of a solid steel plate with holes drilled and reamed to suit. The punch, in reality, is automatic as all that is necessary is to start the sheet between the rolls. One man handles the work and about eight plates may be entirely punched in an hour. The cost of punching each plate is claimed to be nine cents.

Tagging the Elusive Finger-Print

WHAT has been described as the greatest step forward in the science of criminal identification in recent years is the new process discovered by Detective Sergeant Fred G Sandberg of the Washington Police Force This process makes it possible to make finger prints from transparent objects without the use of a camera and lens It consists of covering the finger prints with aluminum powder and then making a direct contact print on to a piece of sensitized film or photographic paper This method has been adopted by the International Association for Identification which numbers among its members some of the foremost finger-print experts in the world

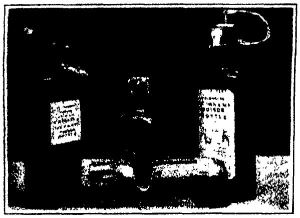
Machine for Testing Shrinkage in Fabrics

CONSUL WALLACE J YOUNG, of Bradford, England, has transmitted clippings from current English periodicals setting forth the result of recent investigations in testing shrinkage in cloths by a mechanical device lately perfected The substance of these reports is as follows

The amount of shrinkage which a cloth has undergone in the process of finishing has about it an element of guesswork, even the expert analyst has had to bring to bear on his work knowledge gained by past experience Comparing the texture under analysis with textures similar in type, he has frequently drawn conclusions which, when put to a practical test, have proved faulty.

In cloths where slight shrinkages take place the matter is not so serious as when the shrinkage reaches as much as 40 per cent, but even with cloths low in shrinkage estimation of finished results are often unsatisfactory

Let it be supposed that an estimated shrinkage is 10 per cent, the actual being 12 per cent To give a finished width of 56 inches the loom widths would be, for 10 per cent, 56 ÷ 0.90 = 62.2 inches, for 12 per cent, 56 ÷ 0.88 = 63.6 inches



Four novel poison bottles exhibited in London before the leading chemists

The rollers handle the sheet through the punch press, reducing cost and time

Applying aluminum powder on finger prints on a glass plate to bring them out

If the cloth is set 62.2 inches, the finished width after 12 per cent shrinkage will be therefore 0.88 of 62.2 inches, or 54.7 inches, in place of the desired 56 inches

Anyone acquainted with the trade knows that a serious loss to the maker would result, as the goods would either be rejected or a claim would be made—the goods supplied being under the specified width If, then, an error of 2 per cent is serious, it is manifest that the determination of the percentage loss due to shrinkage is of vital importance

The usual method adopted for ascertaining the shrinkage of a fabric is as follows A known width and length of the fabric is cut, say, 2 inches square, and threads are extracted reaching from side to side or end to end

The appearance of these threads will be curved or waved It is supposed that the difference between the size of the cloth (2 inches) and the length of the thread extracted, with the curvature removed, by hand, is the shrinkage If the length of the thread is 2½ inches, the percentage of shrinkage is (½ ÷ 2½) × 100 = 20 per cent

To be absolutely sure of the length of the thread it is necessary to know the tension which must be applied in order to bring the thread back to its original loom state The only way to acquire dexterity in this work is to practice with cloths of known shrinkage until the touch is trained to the point of giving just sufficient tension to show the known shrinkage It is quite reasonable to believe that it is possible to produce workers who can with fair accuracy tell the shrinkage of cloth when it does not exceed 20 per cent

In the case of heavily milled fabrics, the tension which would be brought to bear on cloths having only a scoured finish is not great enough to elongate the thread sufficiently It is therefore necessary to practice with milled cloths until a fairly reliable degree of accuracy is attained.

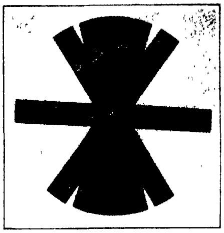
The first difficulty experienced by the beginner in this work is the removal of threads sufficient in number to make an average test As a rule, a cloth with a shrinkage of 35 to 40 per cent placed in the hands of a student is returned with the remark that it is impossible to remove intact a sufficient number of threads to make a test. If, however, the cloth is torn, the thread on each side of the tear is quite easily removed, so that it is only necessary to make a sufficient number of tears to obtain a fair average of threads The threads, when removed, should be placed between sheets of blotting paper, well saturated with water, and allowed to remain for 10 to 15 minutes When removed it will be found that the tension required for stretching will be equivalent to that for scoured cloths

From experiments made by students, this method has been found to yield admirable results, so that one feels justified in saying that the determination of shrinkage is no longer the vested interest of the man with years of experience

The trade should welcome any means insuring greater accuracy, especially if much practice is not required, and will be interested to learn that a machine has been designed by Professor Barker, of Leeds University, for the purpose of ascertaining the contraction of a cloth due to shrinkage

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



The cylinder gage that can't go wrong

A Novel Direct-Reading Automobile Cylinder Gage

BY using a device recently brought out by an Iowa manufacturer it is possible to measure accurately and simply the true size of automobile cylinders The device is made of polished steel one-half inch wide and assembled in sets for various makes of cars In use it is inserted into the cylinder, with the proper blade opened The ends of the blades are true arcs and the measurement is from diametrically opposite points anywhere on the half inch blade The measurement, it is claimed, will be found correct even though the gage should not be held exactly at right angles to the wall of the cylinder being tested

To Catch That Drip

THE good housewife who finds that prohibition has failed to lighten her load to the extent which she had anticipated, and that where formerly the "gang" used to leave her tablecloth spotted with real stuff the only difference today is that the débris consists merely of grape juice, will doubtless welcome the French invention which we picture herewith A brief examination of the picture will convince one that as the vagrant drops of the liquid run down the sides of the bottle, instead of reaching the cloth they are caught up on the projecting points of the little standard in which the bottle sets and conveyed to the space between bottle and metal The enterprising photographer suggests that this little contraption would be of value in connection with catsup and maple syrup, but we prefer to think of it getting as much joy out of life as is possible in connection with the present-day approved form of Navy cocktails

The metal standard catches the drop that rolls down the side of the bottle

New Lantern for Screw Testing

A NEW design of projection lantern, which eliminates the right angle prism and the mirror, has been built recently by the National Bureau of Standards for use in the inspection of screw threads The outfit formerly in service, taking its pattern from a type designed by the National Physical Laboratory of England, was expensive in construction and difficult of adjustment in factories where vibrations are excessive

The newly-built apparatus incorporates the protractor for measuring the thread angle of screws as a component part of the lantern The image is flashed horizontally and the lens system is such that with three different objects having focal lengths of 48, 32 and 16 millimeters, magnifications of 50, 100, and 250 are obtained at a screen distance of 5 feet Rapidity and accuracy are insured, as well as a bright illumination and sharply-defined image for facilitating the view of the operator.

The lantern is likewise adaptable to the measurement of the pitch of thread plug gages and other threaded mechanism When determining the pitch, precision gage blocks are used in conjunction with the micrometer. A setting is made with the image of one edge of the standard angle in coincidence with one side of the thread, a gage block equal in thickness to an integral number of threads is inserted between the micrometer spindle and the ball-end of the center on which the work is held; and thereby the work is displaced laterally at right angles to the axis of the lens system by an amount equal to the thickness of the block Correctness of the test specimens is vouchsafed if the edge of the standard angle is again just in contact with the side of the thread. Otherwise, the amount necessary to bring the micrometer into coincidence reveals the existing error in the sample of lead

Six of these lanterns have been built for the Ordnance Department of the United States Army, and it is anticipated that the apparatus can be applied in the measurement of profiles and templates In actual use, a block is inserted between the micrometer and the center before the initial setting as well as at the second setting

Projection lantern that measures screw-threads in novel fashion

Truck Equipment for Orchard Spraying

A SPECIAL orchard sprayer, designed and built for use on a standard 2½-ton chassis, is stated to be an exclusive product and the only equipment of its kind on the market at the present time. Its perfection is the result of long and studied experiments made with a view to offering to orchard owners a practical and efficient tree sprayer. In a practical trial recently conducted in an orchard, a solution of lime and sulfur was used With a man driving the motor truck and two others using spray guns, the small trees in this orchard were sprayed at the rate of about 150 per hour During the test the sprayer outfit proved clearly its ability to do its intended work quickly and efficiently, and foreshadowed a remarkable improvement in orchard spraying

The tank has a capacity of 6,000 gallons The pump is of the rotary type, driven from the power take-off attached to the transmission The capacity of the pump is 30 gallons per minute against 300 pounds' pressure. The excess capacity of the pump not used by the nozzles is pumped back into the tanks through jets located along its bottom, thereby providing perfect agitation of the spraying liquid.

The ability of this sprayer outfit to deliver two powerful sprays while being driven over the ground at low speed makes it a very fast working sprayer that will surely be a time and money saver to fruit growers. The spray pump operates either while the motor truck is in motion or standing still, and pressure can be maintained at the 300-pound mark without difficulty under all conditions. The spray thrown from the nozzles is exceptionally fine, which means economy in the consumption of spraying liquid This is an important item and assures economy both in the amount of solution used as well as time consumed in spraying. Among the most prominent features of the sprayer may be mentioned that the tank is self-filling, self- agitating and self-cleaning. Of particular importance is the fact that the entire tank and all its attachments are easily removable. This feature enables the owner to use his chassis for general hauling when the sprayer is not in use. Fruit growers will readily see the advantages afforded by this feature as every advantage of a motor truck is retained.

A twist of the knurled thumb-nut squeezes out the tooth paste

Squeezing Out the Last Bit

FRENCH economy and ingenuity are very much in evidence in the tooth-paste dispenser depicted in the accompanying illustration. Here is a little device intended to take a standard tube of tooth-paste and to squeeze the tube by the manipulation of a knurled thumb-nut. In this manner the tube is mounted on a wall, out of the way of dust and dirt; and what is more, the squeezing process starts at one end and is pursued evenly and smoothly until the entire contents have been squeezed out This is in marked contrast to the usual method which gets the tube all out of shape and wastes a good deal of the contents. The details of the device are self-evident in the illustration.

Rowing in the Opposite Direction

THE rowing device shown in the accompanying view makes the rowboat go in the opposite direction to that with ordinary oar locks. That is to say, when the oar handles are pulled toward the rower, the oars are moved backward through the water instead of forward. This causes the boat to move forward or in the same direction as the rower is sitting.

Simple arrangement of oars which makes a rowboat go in the same direction as the rower is facing

Prices—Today, Yesterday and Before the War

(Continued from page 81)

are well borne out by a glance over the list of peak dates. Rubber never during the war or after went any higher than the mark at which it sold in 1914; and it began to decline from that mark as early as February, 1919. Coal, on the other hand, is right now enjoying its peak—it has been going up uninterruptedly all the time. And the peaks in other commodities are fairly well distributed between February, 1919, and December, 1920, they do not by any means enable us to put our finger down at one point on the calendar and say, "Here is the great divide between rising and falling prices."

Our drawings, we think, show the situation up with sufficient clarity to demand a minimum of textual comment and explanation. In each case the size of the object pictured is proportional, *on the three-dimensional basis of bulk represented*, to the amount of the given commodity which may be purchased with a given sum of money.

It will be noted that the commodities employed for this comparison fall into four rather well defined groups. First there are the items which have gone almost as far back as the consumer could hope for them to go—which is to say, they have to all intents and purposes returned to pre-war prices. Copper is actually a shade lower *now* than it was in the good old days of 1914—$100 buys 15 pounds *more*, or roughly, two per cent, now than it did then. Hogs and hides are within ten per cent of being as cheap today as seven years ago, and cotton has made almost as much of a recession.

The second group represents the bulk of our raw materials, which have gone down materially in price as compared with the peaks, but which still are materially higher than they were at the beginning of the war-time movement. Corn is the least offender; we get just seven-eighths as much of it for our money as in 1914. Of sugar we get 70 per cent as much and of wheat 60 per cent Of silk we get 59 per cent as much and of wool 50 per cent. Of steel we get something like 45 per cent as much.

The third group is made up of the coals, anthracite and bituminous, which cost more today than ever before, in the case of the former, and far more than before the war in the case of the latter Since 1914 anthracite has doubled and bituminous has tripled in price. Finally, in a class all by itself, we find rubber—which costs less today than it ever cost.

A little attention to the height of the various peak prices will be of interest The highest quotation for bituminous coal was roughly nine times what it cost in 1914. The price of sugar was multiplied by 6½ between 1914 and the date of its peak; that of silk and of wool by 4½; of corn and of wheat by about 3½; of steel and of cotton by about 3¼; of hides by 3; of hogs by somewhat more than 2½; of coal by 2; that of copper had increased by 3/5 before it turned again.

In any attempt to estimate just how far prices, as a whole, went before turning downward it is necessary to eliminate from consideration altogether the rubber market, which behaved in a fashion so entirely out of the general order of things. On the basis of the other twelve commodities considered, we may calculate that the average peak price brought about a condition under which $100 would buy 32 per cent as much as it would in 1914. The general average for the downward trend since the peak shows that today $100 would buy almost exactly two-thirds as much as in 1914, and therefore a little more than twice as much as at the peak of prices.

The greatest rise in price, as is pretty well known and as is indicated by the

(Continued on page 97)

Use Lupton Service NOW

BUILDING is slack today; labor efficiency is increasing; transportation is better; materials are in good supply.

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Booklets on Lupton Service

We have published four booklets showing examples of Lupton Service applied respectively to: (1) machine shops; (2) foundries, forge shops and other heat-producing buildings; (3) general manufacturing buildings; (4) power houses. Copies will be sent free to any business executive, architect or engineer on request. State what types of building interest you.

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Lupton Steel Partitions and Doors—*Cat. LSP*
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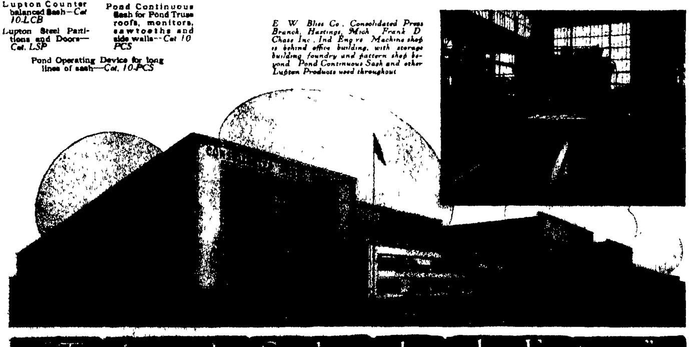


View in main bay of machine shop looking toward front wall

E W Bliss Co, Consolidated Press Branch, Hastings, Mich Frank D Chase Inc, Ind Eng'rs Machine shop is behind office building, with storage building foundry and pattern shop beyond Pond Continuous Sash and other Lupton Products used throughout

"To-day—the Sash makes the Factory"

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Electrical Devices

FUSE BOX—H L Bullock, Box 124, North White Plains N Y The invention relates to magnetic blow-out fuse boxes using copper ribbon fuses, its object is to provide means whereby the operator is enabled to quickly and conveniently renew a blown-out fuse Another object is to insure a positive contact between the ends of the ribbon fuse and the terminal blocks in the fuse box

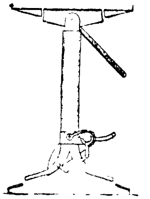
Of Interest to Farmers

PLANTER—H Jones, Manchester, Ga The object of the invention is to provide a device of the character specified adapted for planting hard grain, whatever the size, and for planting grain of several different sizes, at the same time, wherein the construction is simple devoid of intricate parts and of easy adjustment

Of General Interest

DOOR STOP—N Crank Hill City, Kan This invention relates to a door stop to be pivotally fastened on the floor to hold the door in open position An object is to provide a combination door holder and stop capable of holding a door open in any desired position to prevent the premature opening or closing of the door It is also a purpose to provide a door holder having the facility of being adjustable to accommodate doors of various thicknesses

ADJUSTABLE STAND—W V Lewis 38 N College St, Schenectady N Y Among the objects of the invention is to provide an adjustable stand which may serve as a drafting table a reading table or for any similar purpose and which may be readily adjusted to desired heights as well as to desired angles and to provide means for clamping the top in its adjusted position



A SIDE VIEW OF THE DEVICE

SEPARABLE FASTENER—J R Nebeling 21 Maiden Lane, New York N Y The invention pertains to a separable fastening of the head and socket type which may be applied to the strap of a wrist watch or similar article of jewelry The primary object being to provide means by which the head may be positively locked in engagement with the socket A further object is to provide means by which the sliding movement of the locking member is limited

DOLL HEAD—I R Kampfe 271 S Connecticut Ave Atlantic City N J A purpose of the invention is to provide means for manufacturing doll heads and more particularly for manufacturing the faces thereof An object is to provide doll faces with variable features in form and expression which either has a hard unyielding surface or which has a yieldable soft, skin like and pliant surface according to the desires of the manufacturer

DISPLAY CARTON—O C Thum 15 E 10th St New York N Y The primary object of this invention is to provide a carton in which the material or goods contained therein may be advantageously displayed for sale the carton being capable of being closed to protect its contents when not in display position It is a further object to so construct the device that all the printing may be done by a single operation

BOTTLE TOP AND LOCK—W A Wheelock, 908 5th Ave, New York, N Y An object of the invention is to provide a combined cover and lock for a bottle or similar receptacle which is in the nature of a combination lock whereby it cannot be removed until the combination has been properly actuated Another object is to provide a closer wherein the neck of the bottle is formed with a stepped construction and a corresponding shaped cap is provided with locking means for holding the cover in place

COMBINED SHAVING BRUSH AND SOAP HOLDER—J McGuire, 2477 Master St, Philadelphia, Pa Among the objects of the invention is to provide a device especially useful to traveling men or any others whose packing facilities are limited More especially the device embodies a shaving brush having telescopic handle and container for keeping the brush clean and serving at the same time as a soap holder and ejector assuring that the soap may be used most conveniently and economically to the last particle

PROCESS OF CONSTRUCTING FABRIC STRUCTURES—C A Salisbury 61 Ann St, New York N Y This invention relates to theatrical equipments, and it pertains more particularly to a mat or cloth covering for stage surfaces commonly known in the art as ground cloth stage cloth, etc The primary object is to construct a device made from a plurality of individual strips of canvas sewed to form a single mat capable of withstanding excessive wear and the strain to which it is subjected

FASTENER MOUNTING—Bertha Clark, 342 50th St, Brooklyn N Y The object of this invention is to provide a fastener mounting arranged to support fasteners of the stud and socket type in sets to permit a dressmaker to readily sew the fasteners in spaced relation to the article on which the fastener is to be used Another object is to allow the user to readily separate the stud and socket members without the use and breaking of the finger nails

ICE SKATE—M P Smart 97 Chester St, Allston Mass This invention relates more particularly to the foot support and engaging means of ice skate blades the object being to do away with the use of threaded and other detachable parts particularly those which may be unscrewed or otherwise detached and are thereby susceptible to misplacement A further object is the provision of an arrangement capable of ready manufacture at small cost

HAT MIRROR—L W Hosford 1184 Regent St, Alameda, Cal The object of the invention is to provide a mirror convenient for use in emergencies in the form of an attachment for hats or caps, the device including a flap carrying the mirror and an elongated flexible element on the flap adapted to be secured to a hat or cap for positioning the mirror at the sweatband adjacent to a brim or vizor

CROCHET NEEDLE—C E Fairfield, Fennville Mich The invention has for its object to provide a needle wherein resilient holders are provided in connection with the handle for engaging the ball and the thread, to prevent unwinding of the ball and to prevent raveling of the work and to hold the ball, holder and the needle together

DOOR CLOSING DEVICE—C A Purvis, 1705 Jefferson St, Kansas City Mo The invention relates particularly to a spring device for closing doors and for maintaining the same in closed position, a purpose being the provision of a device of this character which is of simple and efficient construction and may be readily applied to doors of ordinary construction

SHAVING STICK HOLDER—R Siller, 1053 E 10th St, Brooklyn, N Y This invention relates generally to a holder for soap, and is particularly adapted for use as a shaving stick holder, the construction being such as will permit a certain part of the shaving stick to extend beyond the holder, a suitable removable protecting holder being provided which in no way comes in contact with the stick but at the same time serves to protect the unused portion

MANUFACTURE OF LITHOPONE—J L Mitchell c/o Natl Lead Co, 111 Broadway, New York N Y This invention relates to a process for manufacturing lithopone which consists of washing and drying a product formed of barium sulfate and zinc sulfide, then pulverizing this product then subjecting it simultaneously to heat and agitation in a muffle furnace to calcine the product, then quenching it in cold water and finally drying it

ARTIFICIAL FISH BAIT—E M Smith, 1020 N 14th St, Birmingham, Ala The object of this invention is to provide an artificial bait, designed particularly for trolling in weedy waters, the bait being so constructed that the hooks are normally housed to be protected from engagement with weeds or other obstructions in the water, the device operating when the bait is swallowed by a fish to release the hooks and allow them to move into exposed position for hooking the fish

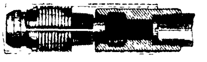
WATCH CLASP—B B Schmeling, 1008 York St, Quincy, Ill This invention has for its object to provide a clasp of the character specified adapted for connection with the pendant of a watch of any type and having means for clasping the material of the pocket between the watch back and the clasp to prevent loss or theft of the watch from the pocket.

FLY SWATTER—B R Jolly, 128 Fayetteville St, Raleigh, N C. The object of the invention is to provide a trigger controlled device consisting of two leaves mounted to swing toward and from each other to grasp the fly between them the leaves being supported by a handle and connected to the handle in such manner that when a trigger is released the leaves will be impaled toward the fly and at the end of their movement will be swung together to grasp the fly between them

WELL SCREEN—H Burgard, 4026 Elk St, New Orleans La An object of the invention is to provide a well screen arranged in such a manner that the screen head may be embedded in a gas water or oil stratum and automatically sealed in position by the strata above Another object is to provide a screen including outer and inner liners with gravel in the space between the liners

Hardware and Tools

PIPE FISHING TOOL—L Wilkinson, Box 66, Sourlake Tex The object of the invention is to provide a tool of the character specified, by means of which a pipe may be easily and quickly grasped for withdrawal from a well without danger of being accidentally released after it is grasped, means, however, being provided for the release when desired



A VERTICAL SECTION OF TOOL

SASH FASTENER—F Dadson Ulen, Minn. The invention relates to devices which function both as fasteners to hold a sash in closed or open position A further object is to provide a fastener especially adapted for use in connection with storm sashes, but which may be used in connection with shutters, box covers or similar devices for holding the movable member

LOCK—M Fleisher 2151 2nd Ave, New York, N Y The primary object of the invention is to produce a lock which is adapted for effective use on doors, safes, etc A further object is to provide a lock having a plurality of simultaneously actuated bolts working in conjunction with a straddle yoke and partly inclosed keeper

NUT LOCK—C G Sebber, 111 N 8th St., Richmond, Va The invention relates generally to nut locks but more particularly to nut locks of the thread gripping type in which the nut has means which automatically act to grip the threads of a bolt, the object being to provide a simple means which will have the advantages of greater ease of manufacture and assembly as well as greater durability in use over the devices of the same general nature heretofore produced.

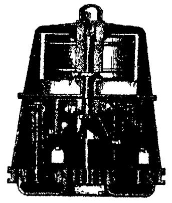
Heating and Lighting

OVEN ATTACHMENT—R. Albrecht, 14 Argyle Pl, Arlington, N. J. This invention relates more particularly to baking ovens utilized for the purpose of making bread, etc. An object is to provide a humidifying medium, formed by pipes permitting a passage of a current of fluid therethrough, and means of heating the fluid to produce a vapor within the baking compartment, that the atmosphere may be surcharged with a definite quantity of moisture.

Machines and Mechanical Devices

CLOTHES DRYING MACHINE.—P. W. White, c/o Universal Club, Cleveland, Ohio. The object of the invention is to provide a clothes drying machine more especially designed for household use and arranged to quickly dry the washed clothes after leaving the wringer and without danger of injuring the clothes To accomplish the result use is made of a casing and a revolving drum adapted to contain the clothes, the drum having a perforated partition and a fan to circulate air through the drum

COMPOUND GRINDER AND PULVERIZER.—S. H Herbst, Jr, 3rd and Summit Ave, Fullerton, Pa The object of the invention is to provide a machine of the character specified designed to crush and pulverize material of every character as, for instance, coal, rock, clinker coke, ore, cement and the like, wherein the material is compounded, ground and delivered, a finished product, ready for the market



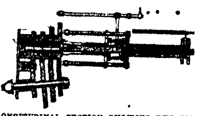
A VERTICAL SECTION OF THE MACHINE

FLEXIBLE COUPLING—W J Francke, Highland Park, N J This invention has for its object to provide a connection arranged to compensate for misalinement of the shafts by the use of flexible members and a floating member. Another object is to equally distribute the pressure, and to retain the floating member in central position between the coupling members and against tendency to float over towards one or other of the coupling members

PACKER—E V Crowell, Box 611, Tulsa, Okla The object of this invention is to provide a device especially adapted for providing a water-tight seal in a well for the purpose of cutting off a flow of water, wherein the arrangement is such that the engagement of the packer with the bottom of the well will automatically expand the packer to cause it to seal the well, and wherein the withdrawing of the packer will contract the same.

OIL LIFT—C W Fisher, Box 246, Coffeyville, Kan Among the important objects of the invention is to provide a swab oil lift which will automatically operate to discharge any oil above the swab in excess of the capacity of the lift and to efficiently retain all oil thereabove without the capacity of the lift, the device is entirely self-acting and of strong and durable construction

VARIABLE SPEED GEARING.—K. K Clark, 120 W 57th St., New York, N Y. An object of the invention is to provide a gear transmission in which the driving and driven gears are always in mesh and to provide means for connecting any of the driving gears with the driving shaft A further object is to provide means for coupling the drive shaft with any one of the driving gears or position the drive shaft so that it turns idly when not transmitting motion to the gears.



A LONGITUDINAL SECTION SHOWING THE SHAFT IN IDLE POSITION

MACHINE FOR DRYING FOODSTUFFS.—N. C. Hebo, 829 Schoupitoulas St., New Orleans, La. The object of the invention is to provide a machine for drying foodstuffs, as for instance hay-meal, ensilage and the like, the machine being so constructed that it will

(Continued on page 98)

LEGAL NOTICES

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

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Prices—Today, Yesterday and Before the War

(*Continued from page 95*)

figures set forth above, was in sugar and in bituminous coal. The greatest recession, if comparison is made with the peak price, is in sugar, of which a dollar now buys nearly five times as much as it did during the sugar panic of the early summer of 1920 The lowest peak was in copper, as indicated above (not counting rubber, of course), the least recovery from the peak has been in steel, of which $100 now buys only half again as much as in last July (this of course excludes anthracite, which is at its peak today). In fact, with the exception of anthracite, and of copper, which had such a low peak that recession is necessarily restricted, there is no other commodity on our list of which the wholesale price has not been cut substantially in half, or more.

The Mississippi's Mouth

(*Continued from page 84*)

soil While some were partially decayed, the most were still well preserved How to excavate through the unusual mass was a problem to which the hydraulic dredge equipped with the regulation runner had no answer.

The general mode of operation was to cut up the roots and stumps with a cutter and then permit the mixture of cuttings, sand and water to be handled in the usual way The complex mass had to be pumped through the dredge But results were poor Mr A B Wood had already designed and patented a centrifugal-pump impeller adapted to the handling of sewage containing trash. The dredging superintendent, Mr. W. J White, heard of this and, basing his expectations largely on an inspection of an impeller for a 12-inch pump, reached the conclusion that this type of impeller was the thing wanted The inventor was ultimately asked to design an impeller for the *Texas* When installed, the results were remarkable During the 30 days immediately preceding installation, the dredge had suffered delays from clogged suction which totaled 130¾ hours During the 30 days immediately succeeding installation, the total of delays for the same reason was cut down to 71½ hours The average yardage was, for the earlier period, 152 per hour, of actual excavation and, for the later period, 445 per hour This is an increase of almost 200 per cent Both propellers, the old and the new, had diameters of 6 2/3 feet However, the new design employed two instead of the former four vanes The new vanes were given a peculiar shape and the space between them was big enough to swallow up a man The form and space combined to facilitate the passage of roots and the like and to make it more or less difficult for them to lodge or collect

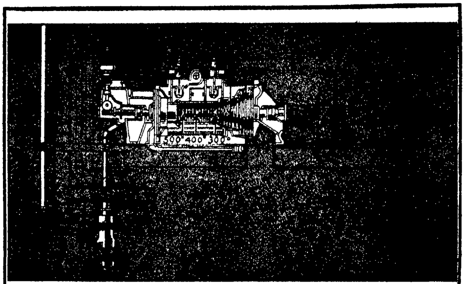
Power in Big Packages

(*Continued from page 86*)

86,000,000,000 kilowat hours Finally, by the more efficient generation of this energy, the coal burned by the superpower system will then be not more than 14 per cent in excess of that now required

Logically, in the establishment of the superpower zone, it is the intention to utilize wherever possible the waterpower resources; but as those familiar with this phase of the subject point out nature has prescribed limits to hydroelectric developments within the area Today the developed hydroelectric capacity has reached 2,198,000 horsepower and it is estimated that the undeveloped sites may give us an additional 3,800,000 horsepower Therefore, when this maximum is attained we must turn to our coal fields principally to meet the continually increasing demand for energy.

As matters stand today, the predominating volume of the coal tonnage used in the superpower zone is obtained from the conveniently located mines of Penn-



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RECENTLY PATENTED INVENTIONS

(*Continued from page 96*)

quickly and thoroughly remove the moisture from the material at a low cost, and within a short time in a continuous passage.

Musical Devices

BRIDLE STRAP ATTACHING TIP.—W. F Ohst, 51 6th Ave., Long Branch, N. J. The invention relates to piano actions and has particular reference to a means for attaching the bridle-strap to the back-stop shank Among the objects is to provide an attaching tip for the bridle-strap which includes means adapted to coact with a tool for positioning the same, thus eliminating the necessity of removing any of the parts of the action The attaching tip is simple, inexpensive to produce and efficient in purpose

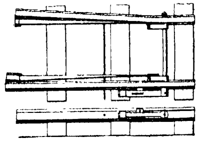
Prime Movers and Their Accessories

SHIM.—J A Sharpnack, Rico's Landing, Pa The particular object of the invention is to provide a device designed to prevent end play of internal combustion motor crank shafts, the shim comprising a flat body having an accurate part adapted to be disposed adjacent to a cylindrical element, and means for securing the body in place An object is to provide a durable shim for taking up wear and preventing end play of motor shafts, and which is particularly adapted for use with crankshafts of automobile motors

GAS ENGINE.—N Arbeiter, 787 State St., Bridgeport, Conn The primary object of the invention is to produce an engine of the internal combustion type having the facility of consuming a fractional part only of fuel for running the engine as compared with the ordinary type of design More specifically, it is an object to produce a gas engine which draws into the explosion chamber about one half of the fuel for running the engine

Railways and Their Accessories

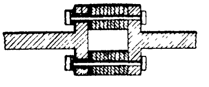
RAILWAY SWITCH.—J H Skogman, 1514 Moffet Ave., Joplin, Mo The object of the invention is to provide a switch lock which engages the switch points and locks the same in set position independently of the switch stand usually associated with switch points for controlling them to thereby preclude any possibility of splitting of the switch—due to the high speed of the passing train, to failure of the switch stand to properly operate or to other reasons



A PLAN VIEW OF THE SWITCH AS INVENTED

TIE FOR MINE RAILWAYS.—F. C Mayer, Bridgeville, Pa The invention has particular reference to railways for mines, tram cars or other railways of a relatively temporary nature Among the objects is to provide a type of railway tie applicable especially for making a reliable joint between metal and wooden rails Another object is to produce a tie adapted for the direct application thereto of either metal or wooden rails

CONNECTING ROD.—V Notarbschi, Struthers Ohio This invention which relates to connecting rods has for its object to provide a rod of the character specified especially adapted for use with railroad switches and the like, wherein the length of the rod must be varied to suit conditions, and wherein the rod is a continuous rigid structure from end to end



A HORIZONTAL SECTION AT THE CONNECTION BETWEEN SECTIONS

Pertaining to Recreation

TOY ANIMAL.—J Levine, c/o Globe Teddy Bear Co., 501 Christopher Ave., Brooklyn, N. Y. An object of the invention is to produce a toy animal for children, which is provided with audible tone [illegible] [illegible] such as a whistle [illegible] in the [illegible] paw or arm of the animal so the toy will respond when taken by the hand or when the animal's hand is grasped by the child, making the toy more amusing.

Pertaining to Vehicles

AUTOMOBILE LOCK.—C R. Ritter, 821 State St., Freeport, Ill. This invention has for its object to provide means for locking the steering post against rotary movement so that it is impossible to steer the automobile, and impossible to operate or drag the car away until the steering post is released The lock can be utilized in connection with any ordinary automobile

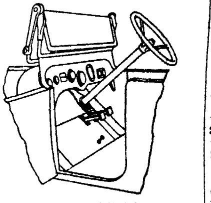


DIAGRAM SHOWING DEVICE IN POSITION

AUTOMATIC STEERING DEVICE FOR VEHICLES.—R De Filippis, 435 Rodney St., Brooklyn, N Y Among the objects of the invention is to provide in connection with a steering member, such as a wheel, or a rudder, a rotary actuator and a connector between the actuator and the steering member, the actuator being provided with means to variably actuate the connector to cause during the rotation any desired control of the steering means either for a straight away course or for the turning of the vehicle

VEHICLE BODY SUSPENSION.—W D Harper, 620 Paterson Ave., San Antonio, Tex The invention relates particularly to a swing suspension for the bodies of motor trucks An object is to provide a suspension between the body proper and the chassis frame for the absorption of shocks ordinarily transmitted to the body where the latter is bolted rigidly to the chassis frame, the suspension being simple in design, efficient in operation, and easily adjustable

HEADLIGHT FOR AUTOMOBILES.—H F Hammond, c/o N A Seraco, 144 Main St., Whitehall, N Y The general object of the invention is to so construct the headlight that a strong, bright light is provided for near illumination of the roadway while a comparatively soft light is thrown forwardly for distant illumination without being objectionable to the occupants of other vehicles approaching or to pedestrians

CONNECTED BLOW OUT PATCH.—R J Levin, 382 Queens Blvd., Winfield, L. I., N Y The invention relates to blow out patches for automobile or other tires, and has for its object to provide a construction wherein a strong and accurately fitting patch is provided regardless of the size or shape of the opening to be repaired Another object is to provide a patch member with a number of connected individual patches adapted to be severed for separate use

Designs

DESIGN FOR A BROAD KNIFE.—J. J. Waters, 175 Park Place, Brooklyn, N Y

DESIGN FOR AN IMAGE.—W S Sidney-Livermore c/o Auto Club of Am., Madison Ave and 41st St., New York, N. Y

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sylvania; and it is equally true that not more than [illegible] per cent of the coal fields east of the Mississippi are situated within easy freight haulage of the neighboring coast. It is manifest, then, that these resources should be conserved as far as practicable for what they represent as natural wealth of steadily increasing value Further, it is plain, that the nearer the coal deposits are to the region of maximum demand the fewer the ton-miles which will be traveled by the railways to effect the indispensable distribution of the fuel. And this angle of the subject brings us to one momentous step toward transportational economy which the institution of the superpower zone will make feasible, *i.e.*, the erection of central stations right in the coal regions and either at the mine mouth or conveniently near These plants would have steam turbo-generating equipments of from 300,000 to 400,000 kilowatt capacity, and would be able to transmit current of 250,000 volts throughout a radius up to fully 250 miles Therefore, instead of the hauling of vast quantities of coal, energy, developed under ideal conditions, would be sent broadcast through the overhead network of conductors

A point of prime importance in evaluating the various benefits to be derived from the institution of the superpower zone is the effect it will have in inducing a great number of small manufacturers and a goodly array of those of a more pretentious character to cease generating their own motive energy. That is to say, these people will confine their efforts strictly to the making of commodities—concentrating their skill upon turning out textiles, hardware, machinery, etc., and leave the field of power production to a group of experts capable of getting the most out of every pound of fuel expended.

To return to the matter of railway electrification in the superpower zone, it should be borne in mind that the central generating plants have been materially improved in their performance latterly A few years back, when the electric tractor showed economies of 200, 250 and 300 per cent in comparison with the steam locomotive in passenger, freight or switching service, the thermal efficiency of the central stations supplying the current did not exceed 8 per cent. Today the thermal efficiency is quite 18 per cent, thus bettering proportionately the savings in fuel The trend is toward bigger steam turbo-generator units having capacities ranging from 50,000 to 100,000 kilowatts, and this increase in size is based upon worth-while economies of various sorts.

Of course, the advantages to be obtained through larger units depend upon running these machines for the greater part of each twenty-four hours at or near their maximum load It seems that when a central station is carrying a load factor of 40 per cent the plant burns something like 85 per cent of its coal before its kilowatt capacity has been taxed 35 per cent, and the startling feature of operation lies in the fact that the remaining 65 per cent of its kilowatt capacity is made available when the boilers are using up the residual 15 per cent of coal

The ultimate consumer has to pay for the fuel wastage in industry; and the manufacturer can hold his own in competition with the foreigner only when cheaper power enables him to offset the higher wages obtaining here. Europe undoubtedly counts upon lower priced commodities to wipe out in the main her debt to us amounting to many billions of dollars. The superpower zone should be an instrument toward stemming this inundation of alien goods which threatens the very industrial life of this nation.

A Matter of Definition

(*Continued from page 87*)

coat who is leaning against the chimney and talking to Miss Brown; after the introduction this long-winded manner of identification is replaced by simple "Mr. Smith." We have added a man to our acquaintance, and a [illegible] [illegible] [illegible] him to our vocabulary.

We ought to be willing to do as much when we are reading a popular essay on a subject which is new to us. If it is worth going into at all, it must embody a certain number of new ideas. Some of these, at least, the writer will think are suited for presentation to us. He introduces them, and names them; is it unreasonable in him to suppose that when next in his discourse he has occasion to refer back to this thing he may do so by name? I do not think it is at all unreasonable; I think he has every right to assume that we have added an idea to our stock of ideas, and to our vocabulary the word he has given us to go with this idea. This is one of the places where the reader simply must abandon the rôle of the bucket But the reader in turn may fairly demand that all new words be thus properly introduced, and that he be not sent to the dictionary.

Some Horrible Examples

As I read what I have written, it seems that I have said nothing to which any sane person could by any possibility offer opposition Yet there are a lot of contestants for the Einstein prize who write as though they were sufficiently sane to have grasped the Einstein theories, yet who seem to differ quite radically with what I have said. Among the words which the reader is apparently expected to know and the notions with which he is supposed to be sufficiently familiar to render superfluous any exposition of their content we find transformations and equations of transformation, continuous and discontinuous functions, the degree of a function, tensors and the order of a tensor, the independence of equations, vectors, arbitrary constants, parameters and parametric equations, conditions of integrability, Gaussians, invariance and covariance, quadratic differential forms, complete and partial curvature—and saving the best for the last, one contestant incorporates in his opening sentence a definite integral Do not misunderstand me; he does not merely talk about definite integrals, he puts one down in black and white, in all its naked and wriggly horror If our printer could set it up I should quote it here; but it goes a trifle beyond his resources.

Another interesting observation to which a reading of the essays leads is the degree to which the writers have tried or refrained from trying to exclude mathematical technicalities. A good number of them have read into our terms an absolute prohibition of all mathematics. No, on second thought I shall have to revise this statement—they have taken it for granted that *algebra* of every description is taboo. The winning essay, it so chances, is entirely innocent of the use of even an *x* or a *t*; but it has not been the understanding of myself or of the judges that this extreme abstinence was necessary, and a number of essays with algebraic expressions in them got the most serious consideration

How Much Mathematics?

That there is something to be said on our side of this question would be clear to anybody if certain of the competing essays were printed. There is beyond question a great deal of geometry that is vastly more complicated, more abstruse, and altogether more removed from the possibility of the layman's comprehension than the elements of algebra. Most of the essays which were scrupulous to the extreme in excluding every suggestion of algebraic notation went quite to the other extreme in matters of Riemannian and four-dimensional geometry, and introduced with the utmost recklessness concepts which cannot by any stretch of the imagination be justified in a popular essay. It seems that this establishes, if not actually bad faith in acquiring the criterion of non-technicality, at least very bad judgment indeed. Moreover, the [illegible]

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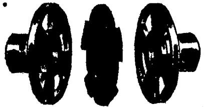

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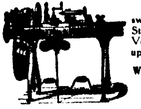

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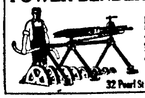

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son who is entirely strange to the fact that letters can be used to represent numbers, to the reasons for such usage, and to some notion of how it is practiced, would be a person quite unequipped to go any appreciable distance in pursuit of modern scientific concepts. I see no reason to suppose that such a person would be interested in Einstein or able to understand anything about him, in any style of presentation. So among the essays that will be published as of the best submitted, there will be found those that go to what the judges have considered to be reasonable lengths in the use of algebra.

Of course horrible examples are at hand here, as before. Complete algebraic demonstration of the principles underlying the Michelson-Morley experiment is a rather common fault, one essayist carrying this to the equivalent of 800 words. The notation of proportion seems rather beyond the elements of algebraic expression, yet it is freely used. One author brings in most of the letters of the alphabet as subscripts, we consider numerical subscripts to be pretty rough on the lay reader, and literal ones almost an automatic disqualification. It may seem trivial to suggest that a man will never read intelligently anything that he can't pronounce, but we think the psychologist will bear us out in this. If he won't, we shall merely have to say that the man who needs all these subscripts, or his fellow who requires all the English letters and most of the Greek ones in the bargain, is carrying his algebra beyond the point that is reasonable in a popular essay. Perhaps more absurd is the idea of one contestant that the linear transformation

$$T'_1 = pT_1 + qT_2; \quad T'_2 = rT_1 + sT_2$$

needed only to be mentioned thusly in order to convey its meaning to the popular audience, or of another, that when he writes

$$ds^2 = g_{ik}\, dx_i\, dx_k$$

with no explanation beyond the parenthetic remark "ten terms written collectively," anybody except the judges was going to know what he was talking about.

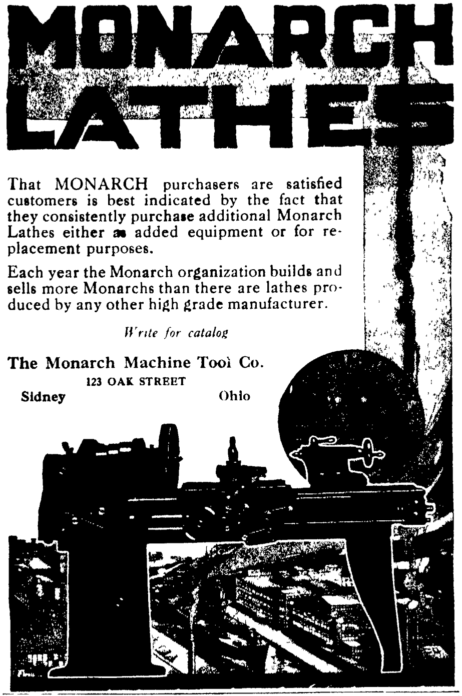
As a matter of fact, excesses in matters of algebraic or analytic notation are not so serious a matter as excesses in the matters of vocabulary or of demands upon the reader's scientific background. Symbols like the above can't be disguised, they shout their presence from the housetops. But unreasonable demands of the other sort are far more insidious. In the first place, the judges are bound to know what the questionable passage means, yet alert as they may be, they are far more likely to fail to realize that it is not intelligible to the layman than if it stood out in all the stark boldness of a summation sign or a flock of differentials. And in the second place, the lessened visual appeal again operates in the case of the lay reader himself. When he comes to a line of symbols that he can't read at all, he knows that he is stuck; but a smooth statement in words that really means nothing to him he may read without his attention ever becoming fixed by the fact that he has failed to understand. Yet it is not desirable to draw the line of demarcation so low that the essays which get over it are so "simple" as to tell nothing of consequence about the Einstein theories. As a matter of fact, as many of those were eliminated as of the other kind.

Where the Printer Gets His Ink

(Continued from page 88)

sheet iron, size 8 feet by 2½ feet, angle iron and plenty of common wire bolts and rivets to fasten the sheet iron on to the frame.

It is common practice for carbon black manufacturers to use a steam engine with high pressure gas as power, then to exhaust the expanded gas into the low-pressure main just back of the gasometer. This furnishes continual power at no expense other than lubricating oil. A thirty-horsepower engine is about the right size



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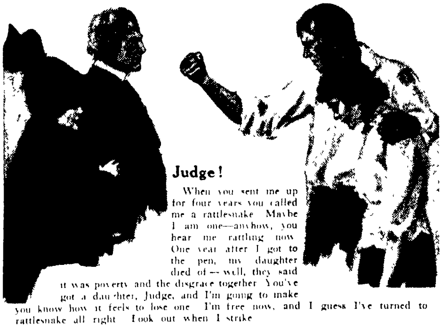

Judge!

When you sent me up for four years you called me a rattlesnake Maybe I am one—anyhow, you hear me rattling now One year after I got to the pen, my daughter died of—well, they said it was poverty and the disgrace together You've got a daughter, Judge, and I'm going to make you know how it feels to lose one I'm free now, and I guess I've turned to rattlesnake all right Look out when I strike

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for a thirty-building plant. The pressure of gas entering the cylinder ranges from fifty to one hundred pounds or about the same as steam The gas is exhausted into the main at a low pressure.

On account of liability of the cylinders to frost, interfering with the lubrication of the piston, the gas is first run through a coil consisting of about 150 feet of two-inch pipe laid in the burning building nearest to the engine, where the gas is heated and enters the engine cylinders, considerably above the atmospheric temperature, and all liability of frosting in the cylinder is eliminated.

After the carbon is scraped from the channel irons or collecting plates it falls down through a hopper or funnel into the carrying pipe This carrying pipe is an eight-inch conveyor pipe running the full length of each burning building and carries a constantly revolving worm which forces the carbon toward the end of the building where it falls into another but larger size conveyor pipe, likewise carrying a constantly revolving worm which forces the carbon to the bolting or sifting house Hence it falls on to a belt conveyor, where it is carried up to a height of ten or twelve feet, where it falls into the first revolving bolter. This first bolter contains a screen of eight meshes to the inch and separates the hard particles, dirt or scale The screened carbon then falls out into a second conveyor and is carried up and dropped into a second bolter where a fifty-mesh-to-the-inch screen is used After passing through the second bolter it is carried to a third bolter, with now a sixty-mesh-to-the-inch screen After being screened in the third bolter it is conveyed to the bin on the second floor of the building where it is kept until it passes through the automatic packers below into the sacks ready for boxing for shipment.

Are We Abusing Our Water Resources?

(Continued from page 90)

plants and animals which form the source of food supply for the fishes Therefore our streams not only lose their attractiveness to the camper and fisherman, but they actually come to be regarded as so much waste and barren water

Just how can this best be brought about? First of all we must remedy the situation of stream pollution This, however, is not an easy matter We cannot establish laws which point blankly prohibit the discharge of any foreign substance into fresh waters That would not be feasible nor economically just In the first place we do not know just what effect the various substances have upon the fish or upon other organisms of the stream Secondly, there are many industrial plants which would be forced to go out of business if they were not permitted to dump their refuse into a nearby stream or lake Some of the wastes could doubtless be transformed into useful products and thus be kept out of the streams but the cost of installing the necessary machinery in many instances becomes prohibitive The whole question needs much detailed and careful study

Organic wastes, such as domestic sewage, milk wastes, etc, should be studied with a view of transforming them into plant and animal life and ultimately into food for man These organic wastes should be the fertilizers of the water and not the contaminators. Some of the European countries have succeeded in turning domestic sewage into fish food. Investigations of thirty or more dairy plants in the State of New York by the author have disclosed some very interesting facts regarding the methods of disposal and possible use of milk wastes. One such industry which manufactures condensed milk discharges every day thousands of gallons of milk washings into a nearby brook This brook thereby becomes entirely depleted of all fish and other fresh water organisms. In place of these an entirely new association of organisms appear, of the kind that grow and thrive in foul waters. The milk washings in the above mentioned brook produced first a thick white fleecy growth which covered the entire bottom of the brook and all overhanging vegetation. This growth was found to be a culture of bacteria held together in these long filaments by a gelatinous secretion. Amidst this bacterial growth occurred myriads of microscopic animals, called ciliata, flagellata, etc. A little farther down stream were found millions of red worms half an inch or more in length. These worms are known as blood-worms and are relished as food by fishes. It was found that the little contaminated brook discharged its water into a larger stream about a mile below the point of entrance of the milk wastes and into this stream the brook brought down the blood-worms in such large numbers that it seemed desirable to estimate the amount of this fish food which was being brought into the stream A conservative estimate showed this to be at least five pounds per hour or 120 pounds every twenty-four hours. The fact that these blood-worms were relished by fishes was shown by the presence of hundreds of fishes, large and small, that were waiting in the larger stream for the appearance of these rich morsels of food Thus through a series of life cycles the waste milk became transformed into the choicest fish food, and though the milk waste contaminated the little brook, it supplied vast quantities of food to the larger stream and thereby made it much more productive of fish life. Such conditions, however, do not exist in many streams, but this example serves to illustrate the possibility of utilizing some of the organic wastes The practicability and exact methods of converting such products into fish food or other useful products need further investigation

The New United States Battleship "Constellation" and Class

(Continued from page 91)

reduced from 24 small to 18 larger boilers, and the whole of this plant is below the protective deck The added beam of the ships has been devoted to anti-torpedo protection, which is so complete in these vessels that it would take several torpedoes to sink them.

By long odds the most daring innovation is the installation of a turbo-electric plant of the enormous capacity of 180,000 horsepower. Current will be generated in four huge main generators and led to the eight propelling motors, of which there will be two, placed in tandem, upon each of the propeller shafts The success achieved by the Navy Department in the collier "Jupiter," followed by the performance with the "New Mexico," and other ships, encouraged the Bureau of Steam Engineering to apply the electric drive on this vast scale.

It is not customary in these days to say much about the armor plan of ships, and both we and the Japanese are reticent on this subject, although the British have given full details regarding their latest armored ships built during the closing years of the war. However, it is evident from the official sketch that "Constellation" will have a water line belt of considerable depth, and it is probable that she will embody sloping armor, built within the interior of the ship, and extending from side to side somewhat like the roof of a house, for the purpose of serving as a shell burster, to detonate shells as far as possible above the protective deck. If this has been done, it will prove to be an admirable protection, worth much more in safeguarding the vitals of the vessel than the same weight of heavier vertical armor would be.

This subject was discussed by the writer in an article published in the Scientific American of April 7, 1917, in which it was shown that the increasing ranges in Naval engagements, with the steeper angle of fall, called for a complete redistribution of the armor.

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STRIPPING SWEET CLOVER PLANTS OF THEIR SEED.—[See page 109]

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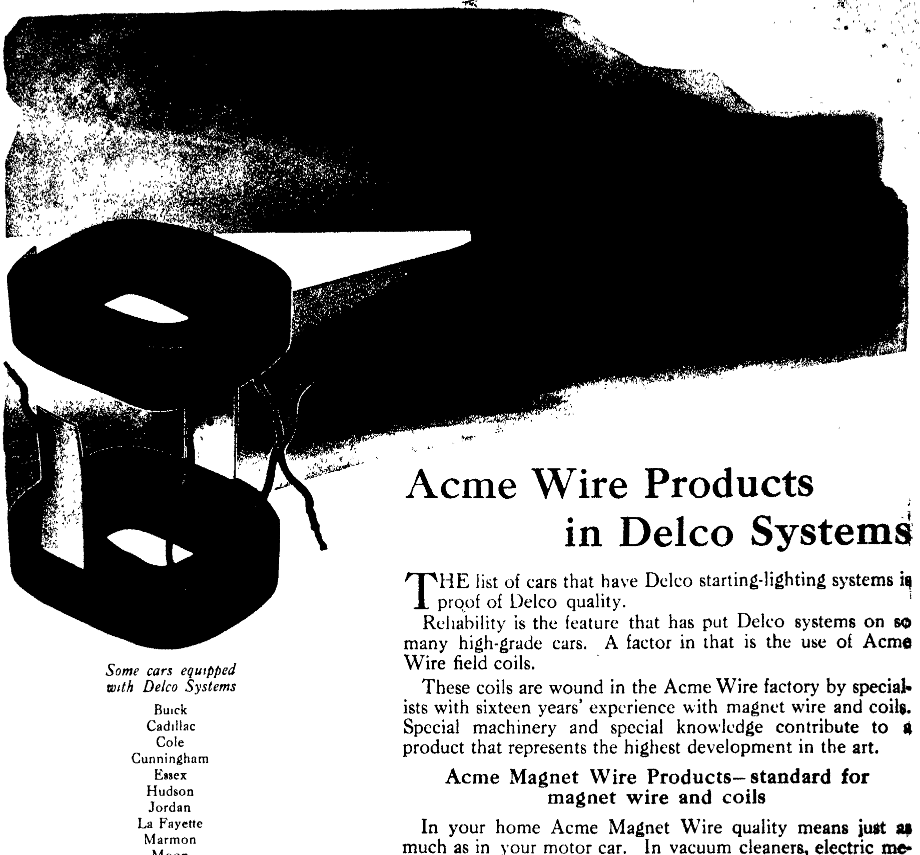

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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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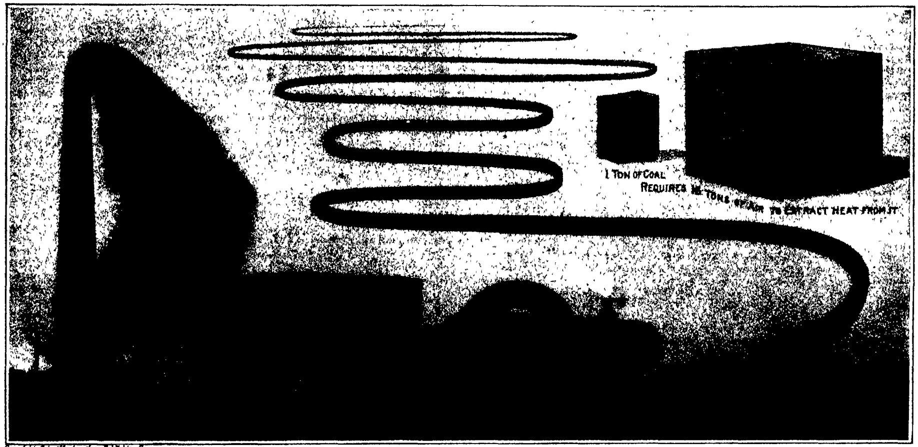
1 TON OF COAL
REQUIRES 16 TONS OF AIR TO EXTRACT HEAT FROM IT

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Some of the facts of coal combustion shown graphically, proving the well-known contention that almost every chimney is a thief

Stopping the Chimney Thief

By Charles C. Phelps

EVERY chimney on every power plant is by nature a thief. Give them a chance and they will rob you of fuel Many have been broken of their heat-pilfering ways by the hand of science but a much greater number of them still stand as monuments to the American spirit of wastefulness

Of two exactly similar chimneys standing side by side, the most skilled observer could not tell by merely looking at them which one was guilty and which one innocent of robbing its owner of heat and of depriving the nation forever of just so much of its most precious natural resource—fuel. Everybody knows that smoke means unconsumed fuel and still a chimney belching forth dense black smoke is very likely to be less of a waster than its innocent appearing smokeless twin. In spite of the popular impression to the contrary, smoke, nuisance though it is on its own grounds, seldom represents a loss greater than one per cent of the fuel

Heat escaping up the chimney represents by far the biggest fuel loss The remaining losses of fuel, principally due to radiation from the boiler and furnace covering and to fuel actually escaping before it has been completely burned, are insignificant in comparison to the chimney loss in the great majority of plants.

"In the average boiler plant, 35 per cent of the heat in the coal burned under the boilers is lost with the stack gases. That is, out of every 100 tons of coal burned under the boilers, the heat of 35 tons literally goes up the stack It is this loss that can be greatly reduced and every effort should be made to do so. The stack loss is so large because its magnitude cannot be readily detected, but can be found only by the use of special instruments and carefully kept records." (*U. S. Bureau of Mines, Technical Paper No. 205*)

Although the above statement refers specifically to coal, similar losses occur when other fuels, such as oil, gas coke and wood, are burned, and in many plants much more than 35 per cent of the heat escapes up the chimney, that figure representing only average conditions Most of this 35 per cent waste is absolutely unnecessary and in plants where the furnaces are operated in accordance with correct principles, this 35 per cent of the fuel is in fact largely utilized in evaporating water into steam, instead of warming up all outdoors. Some of the most efficient power plants actually waste as little as 10 or 12 per cent of their fuel up the chimney This is about as good a result as it is humanly possible to accomplish in the present state of the engineering art

The greater part of the 35 per cent chimney loss is due to using too much air in burning the fuel We have a somewhat similar example in the case of the old-fashioned grate fireplace It is cheery and picturesque but the coal consumed in a grate fire to heat one room would often be more than enough to heat an entire house if it were burned in a modern steam or hot-water heater One reason the grate fire is such a waster is because most of the heat in the fuel is utilized in heating air drawn into the chimney by the draft The heated gases from the fire mix with air and this mixture of hot gas and hot air shoots right up into the chimney before it has an opportunity to give up much of its heat As the hot gases and air ascend the chimney in great volume more air must be drawn into the room continually to take the place of that escaping with the hot products of combustion Cold air necessarily must leak in around the windows, doors, and through various crevices and it then becomes a question whether the heating effect of the fire or the refrigerating effect of the air-leaks will win out.

In burning fuel in a boiler furnace, the same principle is involved If too strong a draft is employed for the amount of fuel that is being consumed, more air will enter the furnace than is needed for the process of combustion and the excess air will simply mix with the hot gases and lower their temperature The excess air will, so to speak, soak up a lot of the heat units that ought to be absorbed by the boiler and will carry them rapidly out of the furnace and up the chimney Excessive draft also means excessive velocity of hot gases passing over the boiler surfaces and *therefore insufficient time to give up heat to the* boiler before leaving it

Before explaining how combustion is controlled with the aid of instruments it would be well to outline the elements of the chemistry of combustion The principal constituent of most fuels is carbon Hydrogen is also an important component of many fuels In the process of combustion both of these elements unite with the oxygen in the air which comes in contact with the fuel and it is this chemical combining of oxygen with carbon and with hydrogen that produces the intense heat in the furnace Other combustible substances are also present but they are usually in such small proportions that they do not contribute very much heat and can therefore be left out of consideration here

The carbon should all burn up to carbon dioxide gas and the hydrogen to water vapor These *gaseous* waste products are often given scant consideration, yet they may aggregate in weight several hundred times as much as the *solid* waste products—the ashes So, if it pays the frugal housewife to sift her ashes with care, how much more profitable must it be for the power plant owner to insist that all of the gases escaping from his furnaces be examined for heat losses!

Combustion being a chemical process, it follows that

(*Continued on page 115*)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

How the Einstein Contest Worked

THE interest taken in the contest from the first, alike on the part of prospective contestants and of those who expected only to read the essays which it would bring forth, has been all that we could have anticipated. The contest must have been very handsomely treated by our contemporaries, for we have received many requests for full information, and a considerable proportion of the contestants appear to have had their first notice of the event through other columns than ours.

Essays were received in greater quantity from Germany than from any other foreign country, doubtless because of the staggering value of $5,000 when converted into marks at current rates. England stood next on the list, and one or more essays were received from Austria, Czechoslovakia, Jugoslavia, France, Switzerland, the Netherlands, Denmark, Italy, Chile, Cuba, Mexico, India, Jamaica, South Africa and the Fiji Islands. Canada, of course, contributed her fair share, and few of our own states were missing on the roll call.

The general level of English composition among the essays from non-English-speaking sources was about what might have been expected. A man may have a thorough utilitarian knowledge of a foreign tongue, but when he attempts intensive literary competition with a man who was brought up in that tongue he is at a disadvantage. We read French and German with ease and Spanish and Italian without too much difficulty, ourselves, we should never undertake serious writing in any of these languages. Not many of the foreign contributions, of course, were as ludicrous as the one we quoted on this page on November 6th, but most of them were distinctly below par as literary compositions. De Sitter and Schlick, mentioned on another page, were the notable exceptions to this, both showed the ability to compete on a footing of absolute equality with the best of the native product. Dr. Schlick's masterly handling of the language it was that got honorable mention in the editorial of November 6th.

A very material proportion of the essays was eliminated on the ground that the authors had not properly carried out the terms of the contest calling for intelligibility to the general reader. As we indicated last week this is of course partly a matter of definition, and of course it is the Judges' definition that must prevail. But it was rather a matter of surprise, on opening the identifying envelopes, to discover the distinguished identities of some of the men who had written with complete misconception of the character of the audience. Our horrible examples of last week should make this sufficiently clear.

We dare say it was a foregone conclusion that many essays should be over the limit, and that a few should be over it to the point of absurdity. The winning essay contains 2,919 words, plus or minus a reasonable allowance for error in counting, that it should come so far from being on the ragged edge should be sufficient answer to those who protested against the severity of the limitation. One inquirer, by the way, wanted to know if 3,000 words was not a misprint for 30,000. Another contestant suggested that instead of disqualifying any essay that was over the line, we amputate the superfluous words at the end. This was a plausible enough suggestion, since any essay able to compete after such amputation must necessarily have been one of extreme worth; but fortunately we did not have to decide whether we should follow the scheme. Perhaps twenty of the essays submitted were so seriously in excess of the limit that it was not even necessary to count their words in detail, most of these offenders ran to 3,500 words or thereabouts, and one of them actually had 4,700. On the other extreme were a few competitors who seemed to think that the shortest essay was necessarily the best, and who tried to dismiss the subject with 500 or 1,000 words.

The first essay received wandered into our office in the middle of September—and it was a good one too. The great avalanche, however, was reserved for the morning of Monday, November 1st. We had been in consultation with the Judges on Saturday, and so had the benefit of three day's mail, there were about 120 essays. Among those which were thrown out on the ground of lateness the honors should no doubt go to the man who mailed his offering in The Hague on October 31st.

We had anticipated that the bulk of the superior essays would be among those received during the last day or two of the contest, for we felt that the men best equipped to attack the subject would be the most impressed with its seriousness. Here we were quite off the track. The seventeen essays which withstood most stubbornly the Judges' efforts at elimination were, in order of receipt, numbers 8, 18, 28, 40, 41, 43, 92, 95, 97, 130, 181, 194, 198, 223, 267, 270, 275, a fairly even distribution. The winner was the 92nd essay received.

Pushing a Good Principle Too Far

THE action of the War Department in demanding that several of the long piers of the Hudson River be shortened will render it necessary for our largest transatlantic liners to dock elsewhere than at Manhattan Island. Several years ago, when the first of the super-liners (if we may use that term), the ill fated "Lusitania" was nearing completion and other still larger ships were contemplated, there was an agitation for an increase in the length of certain piers in the North River to a maximum length of about 1,000 feet. After a very thorough discussion of the pros and cons of this matter, the War Department gave permission for the temporary lengthening of a stretch of piers in the Chelsea District by the addition of 100 feet more or less to their existing length. This renders it possible for such ships as the "Olympic," the "Aquitania," the "Imperator" and the "Leviathan" to berth at these piers with the whole of their length, (in the case of the "Leviathan," 950 feet,) within the shelter of the pier and clear of the North River fairway. The period of years for which this permit for lengthening was granted has now expired, and the companies affected have received a peremptory order to remove the 100-foot extension. The object of the removal is to prevent any interference with the "tidal velocity" in the North River. The companies affected are the International Mercantile Marine and the Cunard Line, the former an American concern, over 95 per cent of whose stock is owned in America, and the latter a British company, and these two between them own the largest ships that are engaged in the transatlantic trade.

Now it seems to us that this action of the War Department is a case of pushing a good principle a little too far. It is eminently desirable, of course, that the Federal Government should exercise a jealous oversight of all great national facilities, prominent among which are our rivers and harbors. The immediate supervision of bulkhead lines and bridge clearances is under the care of the corps of Army engineers, a most able body of men who have fulfilled this part of their duties with conscientious care and on the whole with wise discrimination. Thanks to them, our waterway facilities, in the case both of our rivers and harbors, have been preserved from private exploitation. No bridge can be thrown across a navigable stream without their permission, nor can any pier be advanced into a navigable waterway or harbor beyond the bulkhead lines which they have laid down. Having admitted all this, we feel today, as we have for many years past, that in the matter of encroachments upon the width of the North River at the port of New York, the Army engineers are allowing their zeal to throw their vision out of focus. The question of the advancement of bulkhead lines into a navigable river is one of a nice adjustment between the convenience of shipping passing up and down the river and shipping that is moored to the piers. The minimum width between pierhead lines on opposite shores of the North River at present is about 3,000 feet, or over three times the length of the largest liners that use this port. We fail to see how a plus or minus of 100 feet in a width of 3,000 is going to make any appreciable difference in the velocity of the river current. Experienced river pilots affirm that the 100-foot extension has made no difference in the tidal velocity, or if it has, that it is so small as to be indistinguishable—and surely these pilots, of all men, ought to be the best judges of the behaviour of ships in North River docking.

More serious than the question of current velocity is that of room for maneuvering into and out of the pier basins and interference with passing ships. This is not serious at present, nor can we foresee any time when it will be. Compared with other great ports—Liverpool, London, Hamburg—New York has thousands of feet width to their hundreds. To shorten the piers and curtail the size of ships in favor of the fairway is to sacrifice the greater for the lesser problem.

Monumental Bridge To Be Preserved

THE Board of Estimate of New York City should be congratulated upon its decision to remodel the historic and beautiful High Bridge across the Harlem in accordance with the suggestions of those citizens who wish to see the inherent beauty of the structure preserved. This is to be done by spanning the river with a single stone arch instead of making the crossing with a straight steel span, as was originally suggested.

The rigidly utilitarian spirit which for so many years controlled the growth of this metropolis has been softened, in these later days, by a growing appreciation of the claims which considerations of beauty, harmony and dignity should receive in the planning of city improvements and the design of its monumental structures. There can be no denying that for the lack of this appreciation, New York City has suffered greatly in the years gone by. Historical landmarks which were closely interwoven with the history, not merely of the city, but of the nation itself, have been either ruthlessly swept aside or suffered to fall into irretrievable decay.

The justly celebrated High Bridge came very near to being a case in point. Happily, the demand of the War Department for the removal of certain piers which obstruct navigation in the Harlem River will now be met in a way which certainly will not spoil the appearance of the famous aqueduct, and may well, indeed, be found to grace it with added beauty. The placing of one large arch in the center of the long succession of uniform arches which make up the bridge will introduce a pleasing variety, and in spanning the river in one great sweep, the arch will commend itself to the engineer and the architect as an appropriate solution of the problem. The more so, since the cut stone from the dismantled piers in the river will provide sufficient facing material for the big arch, and will secure the happy result that it will harmonize, not merely in form but in coloring, with the rest of the structure.

Historically, the High Bridge aqueduct will always be of interest, since it forms an important link in the first attempt to provide New York with a water supply adequate to its existing needs and capable of meeting the increasing demands of the future. The Croton dam, the aqueduct and the receiving and distributing basins in Central Park and at Forty-Second Street and Fifth Avenue were all built in the early forties. They have now been outbuilt by the great Catskill reservoirs and aqueduct. High Bridge, however, will remain as a concrete example of the fine work done by the engineers of that early period.

Engineering

The Power of a Cloudburst is vividly demonstrated in the recent experience of Toledo, Ohio. Block paving on a cement sand cushion was washed away during heavy rainstorms. The blocks are being replaced on an asbestos binder course, which provides a much better bottom seal against water. Chicago is also experimenting with asphalt-sand cushions.

California's Water Supply Problems. — Owing to scant rainfall in California, numerous schemes are proposed to provide water for towns and irrigation. Several of these schemes involve large expenditures and all require the movement of water over long distances. In two cases it is proposed to divert rivers completely.

Rapid Filtration. — Sir A. C. Houston's thirteenth research report to the Metropolitan Water Board is sharply criticised from the water engineer's point of view, largely on the ground that slow sand filter beds in practical use are compared as to their working with a minute laboratory experimental filter, consisting of a glass tube of about 18 inches in length and ¾ inch in diameter, in a recent issue of the *Surveyor*.

Steel Tires Imbedded in Concrete. — In order to save head-space a railroad has built bridges at Indianapolis in which the spaces between the cross I-beams are filled with reinforced concrete. This gives a waterproof floor with minimum thickness. The rails are carried on steel sleepers set in the concrete, and are fastened to the sleepers by dogs which can be removed without disturbing the floor.

Rammed-Earth Construction. — Architects are suggesting that the high cost of house building in America be reduced by the use of a compressed earth. Clayey and somewhat sandy loam is mixed with straw or hay to prevent cracking. The wall is built in sections by means of a movable frame into which the moist earth is rammed or beaten in 4 inch layers. The outer surface of this so-called wall can be color washed or treated in various ways.

Road Building in Shantung. — In connection with famine relief measures in Shantung, surveys are being made for the construction of a dirt road from Tungchangfu and Wuting, two important centers in the Province. The proposal would appropriate the sum of $800,000 (local currency). The road will penetrate one of the worst famine districts of Shantung and afford direct connection with the main railway line from Tientsin south of the Yangtse River.

Concrete Beam Tests.—These tests were conducted by the U. S. Reclamation Service at North Platte, Wyoming, under conditions simulating field work and were made to determine the advisability of using a local gravel as an aggregate. Some of the resultant conclusions are of more or less general application, and these may be shortly summarized as follows: (1) The strength of beams covered with sand during curing showed an increase over those not so covered of from 40 to 55 per cent.; (2) 1 : 2½ : 5 beams covered while curing for both 30 and 90 days tests were stronger than 1 : 2 : 4 beams of the same age that were not covered while curing; (3) where concrete dries out too quickly there is a marked decrease of strength.

Corrosion of Railroad Tie Plates. — A series of tests have been made by the New York Central Lines with the idea of finding the magnitude of the corrosion on tie plates, and the best method of reducing its amount. The test plates were inserted either in the track or in exposed positions, and the results show that corrosion occurs mainly on the under surface, the amount of corrosion being measured by the percentage loss of weight during the test. Tests have been made on special steel, Bessemer steel, high carbon Bessemer steel, open-hearth steel, pure iron and malleable iron, such tests taking from 2 to 6 years, and it is shown that the corrosion is a minimum with a steel containing 0.25 per cent copper.

Steel Replacing Wood for Concrete Formwork.—Until two or three years ago formwork has lagged in its development in comparison with other factors in the use of reinforced concrete, states *Technical Review*. The increasing cost of timber, however, is bringing about a revolution in formwork. Steel forms have been used, indeed, for some years in the construction of concrete pipes, tunnels, sewers, and curbs; but they are particularly successful in column work, and have been in use since 1911 for floor work. They are now being introduced in flat slab construction. The chief problem yet to be solved is their application to the construction of concrete beams and girders, after which entire concrete buildings can be constructed from steel forms "with, at least, 95 per cent salvage."

Science

The Federal Government has purchased the Quarantine Station at New York from the State of New York. This includes Hoffman and Swinburne Islands in the outer harbor with their buildings and equipment including the boats. It is desirable to have this great gateway of the Nation under Federal control.

The American Metric Association recently held its fourth annual meeting and discussed the means of introducing the system into the United States. A bill is now before Congress to establish it as a single standard, after a transitional period of ten years. Even the war does not seem to have made any material advance in the use of the metric system. Our present system was described by Professor Kennelly as "the curse of Babylon, the old man of the sea, whose tail is around our necks."

The Alpine Club and Royal Geographical Society are making plans to climb Mount Everest, 29,002 feet above sea level and consequently the highest mountain in the world. All approaches even to the foot hills are practically unknown. Mount Everest is guarded not only by Nature but by man for it lies on the frontier of Nepal and Tibet, two lands virtually closed to the explorer. Fortunately permission has been granted by the Dalai Lama at Lhasa so that the difficulties are now merely those of the mountaineer. The hardships cannot be overestimated and the best experts of the world will be consulted. At least two years will be consumed before there is any likelihood of success. No peak of over 24,000 feet has been ascended, so that it is not known how the explorers will stand the endurance test.

A Depot-Laying Expedition in the Arctic, carried out by Capt. G. Hansen by order of the Norwegian Government for the benefit of Capt. Amundsen, is reported in the London *Times* to have completed its work safely. After wintering at the Eskimo settlement of Thule, in Greenland, Hansen started north in March, 1920, accompanied by several Eskimos who had formerly served under Peary. The party followed the coast of Greenland to the north of Franklin Island and then crossed Kennedy Channel on the ice to Grinnell Land. Cape Sheridan was rounded with difficulty, on account of extremely rough pack, and the goal of the expedition was reached at Cape Columbia, Grant Land. The series of depots laid to that point will enable Amundsen, if his drift brings him near Cape Columbia, to travel thence by easy stages to the Danish settlements in Greenland.

The "Bicentenary" Expedition to North Greenland.—Under this title Lauge Koch, the Danish explorer, sets forth in the *Geographical Review* his plans for a geographical and geological expedition to North Greenland during the year 1921, which is the 200th anniversary of Hans Egede's departure from Copenhagen as a missionary to Greenland, the first step in the systematic colonization of Danish possessions in the Arctic. Lauge points out that the whole coast line of Greenland is now known, and that the coast of Peary Land, the most inaccessible part of Greenland, has been reached from both sides. The interior of Peary Land, however, is absolutely unknown. The new expedition is already in the field, having sailed from Copenhagen July 15, 1920 for Robertson Bay, in Inglefield Gulf, where it was to winter. Koch is accompanied by a Danish engineer, C. F. Slott, who is an expert in the use of tractors, which are used in carrying provisions across the inland ice.

Geothermal Data of the United States.—U. S. Geological Survey Bulletin 701 by N. H. Darton, is a collection, by states, of all available data of subterranean temperatures in this country. Several hundred of the observations recorded in this bulletin were taken by the author and his associates with the Darton self-registering maximum thermometer, which is a slight modification of that used by William Hallock. The geological relations of the wells in each state are discussed. In most wells that penetrate sedimentary rocks not greatly disturbed there seems to be no distinct relation between the formation penetrated and the geothermal gradient. A striking exception is the Des Moines well in Iowa, which shows a sudden change from a rate of increase of 1 degree in 75 feet above the Devonian to 1 degree in 272 feet below the top of it. The Comstock Lode, Nevada, is noted in the bulletin as a well-known instance of the influence of hot volcanic material below the surface in raising the geothermal gradient. In the state of Washington heat from old lava flows is assumed to be the cause of unusually hot flows of water from wells. Unusually low gradients in the northern Peninsula of Michigan have been ascribed to the proximity of Lake Superior.

Automobile

Production Costs in England.—Interesting comment on the increased costs of production in England is contained in the house organ of a Nottingham automotive manufacturer. He states that mechanics' wages have increased over 200 per cent, laborers' wages 300 per cent, and apprentices' wages 240 per cent. Similar increases have occurred in the prices of materials, lumber costs having increased 210 per cent, iron castings 235 per cent, steel 185 per cent, stampings 215 per cent and aluminum 175 per cent.

Recovering an Automobile Top.—It is no longer necessary for the motorist to take his car to a trimmer or to any shop to have the top repaired or renewed. A new cover for the top can be purchased, made up in such a manner that one can put it on one's self without very much effort. These new covers are all sewed together complete with tacks, curtain fasteners, binding, welts and with printed instructions telling just how to take off the old cover and apply the new. It is so simple and prices are so low that a saving of fully 50 per cent is made on the price of a new top. A perfect fit is guaranteed when the correct name, year and model number is given of the car the new cover is wanted for. Covers are tailored to fit that car and are made in sufficient variety to fit every kind of car that was ever built, so the makers claim.

Spark Plug Sold Under Three-Year Guarantee.—So firmly convinced is a prominent spark plug concern that their spark plug is unbreakable, that they have inaugurated an extensive national advertising campaign which is now being conducted through the various channels of publicity to the trade and motoring public stating that they fully guarantee each plug against breakage and defective workmanship for a period of three years. Hereafter every spark plug purchaser will receive a signed guarantee bond with each plug. If, within a period of three years from date of sale this plug should break or prove defective through no fault of the owner, it will be replaced absolutely free of charge if mailed together with the proper signed bond direct to the nearest branch or to the factory. This proves how thoroughly various automotive products have been developed and shows how one part that formerly gave considerable trouble has been improved to the point where such a broad guarantee can be given.

Truck Legislation and Food Costs.—It is estimated that during the past year approximately 350,000,000 tons of farm products were hauled to market in motor trucks by the farmers and gardeners of the United States, and the actual operating figures show that motor truck transportation is twice as cheap as horse drawn transportation. Thus it will be seen, says a prominent manufacturer, that legislation which hits motor trucks hits at the very source of the life supply of the people; to unwisely legislate against the motor truck is to take food away from those who need it and to increase its cost. Much of this 350,000,000 tons of food products hauled from the farm to the city by trucks was of a perishable nature, and hundreds of thousands of tons of it would have been lost but for the rapid transportation possible with the motor truck. The motor truck serves the needs of the people and it is for the people, both producers and consumers, to see that the motor truck is given a square deal and is not discriminated against.

Code of Approval Signals. — Register of Motor Vehicles Frank A. Goodwin of Massachusetts has approved a series of hand signals for power vehicle drivers which are practically the same as have been approved by the state officials of Connecticut, and the Massachusetts Safe Roads Federation has undertaken to carry on a campaign of education among all who own and drive automobile cars and trucks. The signals are described as given by a driver seated at the left side of the machine, but they can be given just as well with either hand. The code is as follows: Stop, extend the left arm and hold it stationary, with all fingers extended and close together. Left turn, extend the left arm and hold it stationary with the index finger pointing and the outer three fingers closed. Right turn, extend the left arm with the fingers extended and the palm upward and rotate it from the rear to the front. Back, extend the left arm with the fingers open and close together and the palm vertical, and move it upward and downward from a horizontal position. Turning, give the "Left Turn" signal and repeat it until the vehicle has been turned and can be driven directly ahead. When turning always drive forward and turn into and with the traffic moving in the direction opposite to line of original movement. The arm of the driver should always be extended full length and held a sufficient length of time to justify observation of the drivers following.

Open Roads All Winter

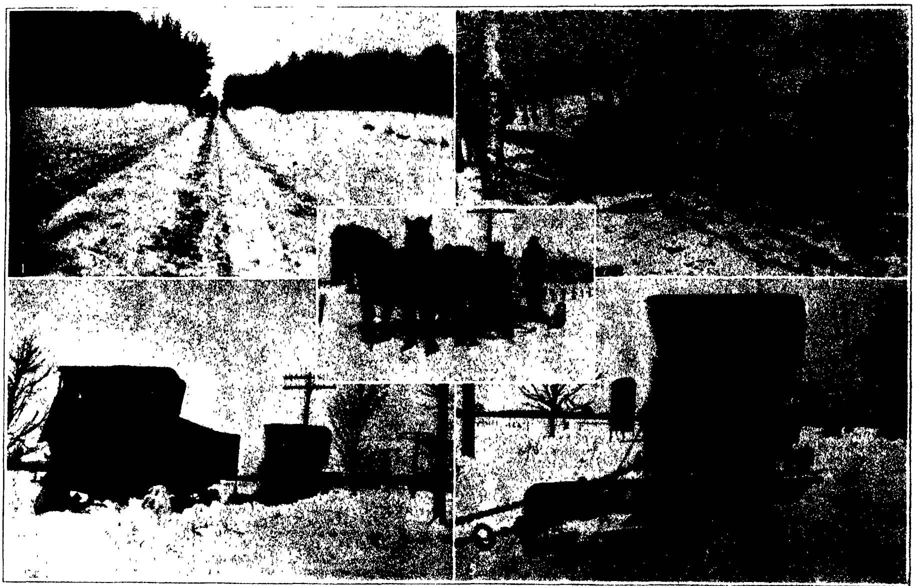
Definite Snow Removal Program in Northern and Eastern States

By M. R. Reynolds

TRUNK roads in every State west of the Mississippi and north of the Potomac, except Maine, Vermont, New Hampshire and New York, are being kept clear of snow this winter for the first time in history, and the automobilist who desires to use his passenger car or motor truck during cold weather can do so nearly, if not quite, as successfully as he could in the summer

In the past, when highways served only their immediate locality there were no serious consequences if the roads in the Northern States remained impassable for three to five months each winter because of snow Sleighs took the place of wheeled vehicles while the snow was on the ground, and at points where the road was drifted full, the traffic detoured through the fields. With the coming of the automobile and motor truck, conditions have changed. Twenty five miles now are as five in the day of the horse, and an open highway 365 days in the year is necessary

In the transportation of many kinds of freight, motor trucks have supplanted the railway in various sections of the country One of the principal reasons for this is that commodities can be moved short distances more quickly by truck than by train If the truck is to retain the place it has won during the last four years, the main highways which it traverses must be kept open all winter Modern highway transportation cannot be carried on at convenience and treated with indifference Railroads do not abandon their shippers when snow drifts block transportation, although it would often be more profitable to stop train service until the rails are cleared by natural agencies Railroad officials realize, however, that production stops when transportation halts, and they use every effort to move traffic with daily regularity



1. A well-cleared stretch of road 2 Ruts that are worn in the roadbed when covered with snow become miry mudholes in spring. 3. The ordinary road grader will remove a moderate cover of snow 4 Where the fall is very heavy two trucks propel a scraper blade. 5. Ordinary drifts are amply cared for by a single truck pushing the scraper

Keeping our northern roads free of snow during the winter

Production has increased more rapidly in recent years than the capacity of the railroads, and the motor truck has stepped into the breach and made good. This is demonstrated by the increased amount of freight tonnage moved annually by motor trucks, indicative of the relatively constant freight traffic over roads which are open the year round. Rural products, particularly those of the dairy, are almost entirely dependent on the highway, and in some of the Eastern States factory interchange is now largely carried in trucks

Heavy expenditures of money are necessary to keep the main trunk roads open in the North and West during the winter months, but in sections where the work has been carried on in former winters, its value has been so apparent that a concerted effort is being made this winter to keep the main highways in all the States north of the Potomac and west of the Mississippi open to motor transportation. The Bureau of Public Roads of the United States Department of Agriculture made a study last summer of the situation in these States with regard to snow removal. As a result of this survey, the bureau has prepared a map which shows the roads that will be kept open in Connecticut, Massachusetts, Delaware, Maryland, New Jersey, Pennsylvania, Michigan, Indiana, and Illinois In other States, notably Ohio, snow removal is the task of the towns or counties, and while the State highway department assists in every way possible and urges the necessity of the work, it is not authorized to initiate it. Thus far, snow removal in the States in which it has been attempted has worked admirably. In event of extremely heavy snow in sections not well prepared to handle its removal, difficulty may be experienced in keeping the specified roads open, but highway commissioners learn through experience and a failure this year may be turned into eminent success next winter.

The plans for keeping the highways open in winter differ somewhat in the various States, but their actual field methods are similar. Preventing snow from drifting into the highways in objectionable quantities and its removal after it has lodged there are the two main groups of activities of the snow program. Prevention in this work, as in many other kinds, is cheaper than remedy.

Snow falls uniformly and lies as it falls when there is no wind with the snowfall. Usually, however, there is more or less drifting. Snow moved by the wind is not usually lifted far above the surface of the ground, the distance depending upon the velocity of the wind. It is then deposited on the leeside of obstructions as back of such obstructions there is a body of relatively quiet air. Almost any obstacle such as weeds, hedges, and fences will clear the air current of snow by causing it to be deposited in the relatively quiet space back of these obstructions.

The first step in preventing snow from drifting into the road is to remove from the right-of-way everything that can cause drifting. Weeds and tall grass, the most common sources of trouble, should be cut down and removed even if they are no more than a foot or two high. Hedges, trees, and tight fences made of rail, stone, or picket also may cause highways to fill with drifts. Wire fences being open offer no obstruction to the wind and do not create a condition in which snow will be deposited. Many of the obstructions which cause drifting can be readily removed, but trees and

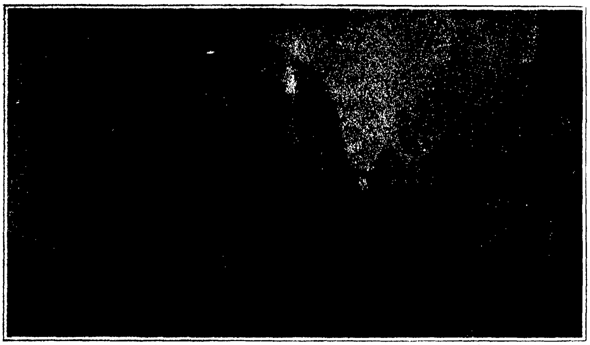
(Continued on page 117)

Stunts of the Stage

By Harry A. Mount

WHEN the theatrical producer is able to bring from his audience a gasp of astonishment and the query "I wonder how they did it?" he feels he has scored a triumph of technique. Occasionally the whole action of a play is built around some "stunt" the staging of which calls for the services of a mechanical engineer. There is one such in New York now. And in several other of the new productions mechanical genius has added some striking or surprising feature.

Practically all of the American plays are "manufactured" in New York. Many of the mechanical effects require cumbersome paraphernalia or even alterations of the stage or theater and so cannot be taken on tour. A glimpse from "back stage" at some of the thrillers along Broadway may prove interesting alike to those who will not have the opportunity to gasp at them personally and to those who will visit one or more of the productions and wonder "*How is it done?*"



Scene in which the airplane "crashes" to the stage with all the realism of a serious accident

"The Broken Wing" is the play referred to above. It is fabricated from the adventures of an American airman who crashes his plane in Mexico In the first act a real airplane crashes to the stage with all the realism of a dangerous accident. Not long ago the maker of the particular airplane used in the show asked permission to view the "crash" from behind the scenes He was readily granted permission but advised *not to do it.*

"It will spoil it all for you," he was told.

For this staged "crash," like many other stage effects, is mystifying chiefly because it is done so simply. It is well known that the magician often relies upon the fact that the mind usually seeks a complicated, rather than the simple and obvious explanation for what we see, to hide his tricks.

In this case a carefully selected rope is attached to the airplane in such a way that it breaks just before the machine strikes the stage and takes up most of the shock of fall The wings are loosely fastened so that they break off when the rope snaps. The airplane is complete with its engine but the compression has been relieved and the propeller is given a whirl just as the machine starts its drop. It carries two men in its plunge to the stage and a real airplane motor roaring in the wings, up until the instant of the fall, makes the illusion convincing A *safety cable, anchored back of* the stage, passes through the fuselage and around the motor so that there is no chance that the machine, weighing over a thousand pounds, will plunge into the audience. The strength of the check rope, the height of the fall, etc., have been calculated so nicely that the same machine is able to crash to the stage every day, and sometimes twice a day, with only minor repairs from time to time

In "Sally," a new Ziegfeld production, the audience is started during a ballet scene in the last act when the whole stage, carrying a chorus of about thirty, moves forward until it covers the orchestra pit, and then glides back into place

The mechanism of this effect also is very simple The stage used is a double one, the upper stage being simply a low platform mounted on wheels, the forward half having no support During the first part of the scene two wedge-shaped platforms fit snugly against the forward edge, serving to give it the appearance of a solid stage *only slightly elevated and* to support the forward half Just before the stage is moved forward, these pieces are pulled into the wings Most of the chorus is moved to the back of the stage so that it will not tilt and it is then moved forward by means of a windlass mounted beneath A safety cable allows the stage to go forward a certain distance and then it is pulled back and the wedges slide back into place.

The New York Hippodrome is famous for its elaborate stage *effects* and it supplies this year perhaps the most mystifying of the "thrillers." In the final act a considerable portion of the chorus march with heads erect, like soldiers on dress parade, down a set of steps into the great bathing pool with which the stage is equipped They sink down step by step until the crowns of their heads finally disappear beneath the water. The strange part is that they do not come to the surface. Apparently they have been swallowed up *or dissolved by the water.*

From "back stage" one sees quite a different performance. As each girl sinks beneath the water she dives and swims beneath the water to the front of the tank and then comes to the surface under a shield dropping from the footlights They walk to the side

(*Continued on page 118*)

The World War on Rats

By George Gaulois

PRACTICALLY the entire world is participating in a new war Because of the humdrum nature of this gigantic conflict, little has been heard of it by the man in the street. There are no spectacular bombardments or tank attacks or brilliant generals to talk about, to be sure; yet the world's foremost scientists doctors, engineers and government authorities have enlisted in the ranks of the combatants, and millions upon millions of dollars are being expended in order that a decisive victory may be scored by humanity

In brief, this world wide war is on rats And when we say rats we have said plagues and diseases and other disagreeable things that can be blamed on the world's rats

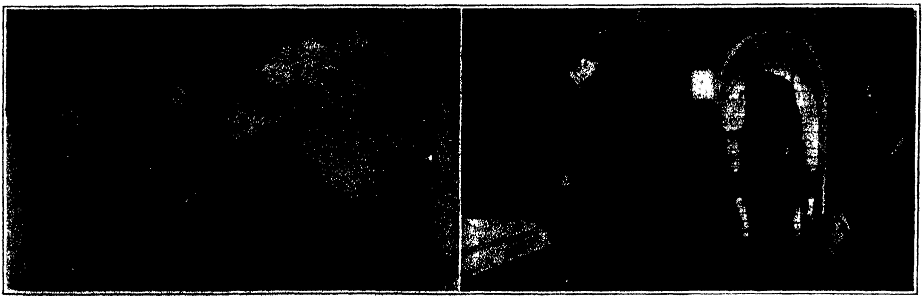
Now the queer feature of this war is that the rats are not altogether to blame They simply are the agents for the ultimate enemy They carry the lice on their hairy coats, and the lice, in turn, carry the bacilli which are the true and ultimate trouble makers The rats bring the lice to the living quarters of man, and the lice in due course attempt to attach themselves to man It is by stinging man that the lice introduce the dangerous bacilli into man's system, thus completing the chain of events which are the bottom of many plagues

Of rats there are a great many It is estimated that in Paris alone there are over five million rats—considerably more *than the* human population The damage caused by these rats is too well known to require elaboration, a person of mathematical mind might find much diversion in calculating how much food such a vast colony of rats consumes a year

The war on rats may be conducted on an offensive or defensive basis depending upon conditions In offensive operations the character of the work varies according to whether the rats are hunted in the open or in spaces *capable of being hermetically* sealed Obviously, the best methods are those which destroy the lice as well as the rats, for there is little gained if the lice are permitted to seek refuge on man or nearby animals

In places capable of being hermetically sealed, recourse is had to asphyxiating gas, and as a rule sulfurous gases are employed The heavy gases are directed into corners in order that they may sink down *into rat holes and hidden places The operation* terminated, the space is energetically ventilated to render the atmosphere normal and to prevent the deterioration of various surfaces, which are often affected especially when warm and humid gases are used The last traces of gas can be destroyed by vaporizing ammonia.

(*Continued on page 118*)



Left: An electric flash lamp serves to blind the rats in this underground passageway while one of the hunters swoops down on them with his net. *Right:* Preparing the gas generator for gassing the rats in a hermetically sealed space. The men shown in both these views are professional rat hunters, undertaking contracts for ridding institutions of rats

With the rat hunters of Paris. These men have made rat hunting a profession and receive high remuneration for their efforts

Relativity

The Winning Essay for the Eugene Higgins Five Thousand Dollar Prize

By "Zodiaque" (L. Bolton, London, England)

IN their work of gradual elimination of those essays which were not the best, the Einstein Judges found that by all means the most effective test to apply was that which arises from the fact that when a man writes about the Einstein theories in 3,000 words, the most momentous problem confronting him is what to leave out. Examination of the essays brought to light without much difficulty about twenty that stood out well above the others in this regard. Mr. Bolton's winning essay is the example par excellence of this merit of advantageous selection. Everybody will of course agree that he says admirably what he has to say, but the real reason why his essay was ultimately chosen over its most pressing rivals was the extraordinarily fine judgment which he used in deciding just what he would say and what he would leave unsaid. We do not believe it would be possible to make any material improvement upon Mr Bolton's selection of the ground to be covered in an essay of this character.—THE EINSTEIN EDITOR.

THE reader is probably acquainted with the method of specifying positions of points in a plane by their distances from two mutually perpendicular lines, or if the points are in space by their distances from three mutually perpendicular planes like adjacent sides of a flat-sided box. The method is in fact in common use for exhibiting relations between quantities by graphs or diagrams. These sets of axes as they are called together with any scales used for measuring, must be supposed rigid, otherwise the events or points which they are used to specify are indefinite. The lengths which locate any point with reference to a set of axes are called its coordinates.

When such systems are used for physical purposes, they must be supplemented by clocks to enable the times at which events occur to be determined. The clocks must be synchronized, and must go at the same rate, but it must suffice here to state that this is possible without indicating how these conditions can be attained. A system of axes with its clocks will hereinafter be called a Frame of Reference, and every observer will be supposed to be provided with such a frame partaking of his motion. All the objects which partake of an observer's motion will be called his *system*.

It is a question whether among all possible frames of reference any one frame or class of frames is more suited than another for the mathematical statement of physical laws. This is for experience to decide and a Principle of Relativity is a statement embodying the answer.

The Mechanical Principle of Relativity

It has been ascertained that all such frames are equally suitable for the mathematical statement of general *mechanical* laws, provided that their motion is rectilinear and uniform and without rotation. This fact is comprehended in the general statement that *all unaccelerated frames of reference are equivalent for the statement of the general laws of mechanics*. This is the mechanical principle of relativity.

It is well recognized however that the laws of dynamics as hitherto stated involve the following assumptions:

(1) Lengths of rigid bodies are unaffected by the motion of the frame of reference.

(2) Measured times are likewise unaffected.

That is to say that any length measured on his own system by either of two relatively moving observers appears the same to both observers, or that lengths of objects and rates of clocks do not alter whatever the motion relative to an observer. These assumptions seem so obvious that it is scarcely perceived that they are assumptions at all. Yet this is the case and as a matter of fact they are both untrue.

The Special Principle of Relativity

Although all unaccelerated frames of reference are equivalent for the purposes of mechanical laws, this is not the case for physical laws generally as long as the above suppositions are adhered to. Electromagnetic laws *do* alter their form according to the motion of the frame of reference, that is to say, if these suppositions are true, electromagnetic agencies act in different ways according to the motion of the system in which they occur. There is nothing *a priori* impossible in this, but it does not agree with experiment. The motion of each locality on the earth is continually changing from hour to hour but no corresponding changes occur in electromagnetic actions. It has however been ascertained that on discarding these suppositions the difficulty disappears, and electromagnetic laws retain their form under all circumstances of unaccelerated motion. According to the theory of relativity, the correct view which replaces these suppositions is deducible from the following postulates:

(1) By no experiment conducted on his own system can an observer detect the unaccelerated motion of his system.

(2) The measure of the velocity of light *in vacuo* is unaffected by relative motion between the observer and the source of light.

Both these postulates are well established by experiment. The first may be illustrated by the familiar difficulty of determining whether a slowly moving train one happens to be sitting in, or an adjacent one, is in motion. The passenger has either to wait for bumps (that is, accelerations) or else he has to look out at some adjacent objects which he knows to be fixed, such as a building (that is, he has to perform an experiment on something outside his system), before he can decide.

The second postulate is an obvious consequence of the wave theory of light. Just as waves in water, once started by a ship, travel through the water with a velocity independent of the ship so waves in space travel onward with a speed bearing no relation to that of the body which originated them. The statement however is based on experiment and can be proved independently of any theory of light.

It is not difficult to deduce from these postulates certain remarkable conclusions relating to the systems of two observers, A and B, in relative motion, among them the following:

(1) Objects on B's system appear to A to be shorter in the direction of relative motion than they appear to B.

(2) This opinion is reciprocal. B thinks that A's measurements on A's system are too great.

(3) Similarly for times each observer thinks that the other's clocks have a slower rate than his own, so that B's durations of time appear shorter to B than to A, and conversely.

(4) Events which appear simultaneous to A do not in general appear so to B, and conversely.

(5) Lengths at right angles to the direction of motion are unaffected.

(6) These effects vary with the ratio of the relative velocity to that of light. The greater the relative velocity, the greater the effects. They vanish if there is no relative velocity.

(7) For ordinary velocities the effects are so small as to escape notice. The remarkable point however is their occurrence rather than their magnitude.

(8) The observers similarly form different estimates of the velocities of bodies on each other's systems. The velocity of light however appears the same to all observers.

Taking into account these revised views of lengths and times the mechanical principle of relativity may be extended to physical laws generally as follows: *All unaccelerated frames of reference are equivalent for the statement of the general laws of physics.* In this form the statement is called the Special, or Restricted, Principle of Relativity, because it is restricted to unaccelerated frames of reference. Naturally the laws of classical mechanics now require some modification, since the suppositions of unalterable lengths and times no longer apply.

The Four Dimensional Continuum

Lengths and times therefore have not the absolute character formerly attributed to them. As they present themselves to us they are relations between the object and the observer which change as their motion relative to him changes. Time can no longer be regarded as something independent of position and motion, and the question is what is the reality? The only possible answer is that objects must be regarded as existing in four dimensions, three of these being the ordinary ones of length, breadth and thickness, and the fourth, time. The term "space" is applicable only by analogy to such a region, it has been called a "continuum" and the analogue of a point in ordinary three-dimensional space has been appropriately called an "event." By "dimension" must be understood merely one of four independent quantities which locate an event in this continuum. In the nature of the case any clear mental picture of such a continuum is impossible, mankind does not possess the requisite faculties. In this respect the mathematician enjoys a great advantage. Not that he can picture the thing mentally any better than other people, but his symbols enable him to abstract the relevant properties from it and to express them in a form suitable for exact treatment without the necessity of picturing anything, or troubling whether or not the properties are those on which others rely for their conceptions.

Gravitation and Acceleration

The limitation of statements of general law to uniformly moving systems is hardly satisfactory. The very concept of general law is opposed to the notion of limitation. But the difficulties of formulating a law so that the statement of it shall hold good for all observers, whose systems may be moving with different and possibly variable accelerations, are very great. Accelerations imply forces which might be expected to upset the formulation of any general dynamical principles, and besides the behavior of measuring rods and clocks would be so erratic as to render unmeaning such terms as rigidity and measured time, and therefore to preclude the use of rigid scales, or of a rigid frame of reference which is the basis of the foregoing investigation.

The following example taken from Einstein will make this clear, and also indicate a way out of the difficulty. A rotating system is chosen, but since rotation is only a particular case of acceleration it will serve as an example of the method of treating accelerated systems generally. Moreover, as it will be seen, the attribution of acceleration to the system is simply a piece of scaffolding which can be discarded when the general theory has been further developed.

Let us note the experiences of an observer on a rotating disk which is isolated so that the observer has no direct means of perceiving the rotation. He will therefore refer all the occurrences on the disk to a frame of reference fixed with respect to it, and partaking of its motion.

He will notice as he walks about on the disk that he himself and all the objects on it, whatever their constitution or state, are acted upon by a force directed away from a certain point upon it and increasing with the distance from that point. This point is actually the center of rotation, though the observer does not recognize it as such. The space on the disk in fact presents the characteristic

WE, the Judges in the Einstein Prize Essay Contest, hereby state that it is our united judgment that the essay "Relativity," submitted under the nom de plume "Zodiaque," is the best essay received within a proper interpretation of the conditions and aims of the contest; and we award to its author the prize of $5,000 offered by Mr Eugene Higgins of Paris.

Leigh Page
E. P. Adams.

properties of a gravitational field. The force differs from gravity as we know it by the fact that it is directed away from instead of toward a center, and it obeys a different law of distance, but this does not affect the characteristic properties that it acts on all bodies alike, and cannot be screened from one body by the interposition of another. An observer aware of the rotation of the disk would say that the force was centrifugal force; that is, the force due to inertia which a body always exerts when it is accelerated

Next suppose the observer to stand at the point of the disk where he feels no force, and to watch someone else comparing, by repeated applications of a small measuring rod, the circumference of a circle having its center at that point, with its diameter The measuring rod when laid along the circumference is moving lengthwise relatively to the observer, and is therefore subject to contraction by his reckoning When laid radially to measure the diameter this contraction does not occur. The rod will therefore require a greater proportional number of applications to the circumference than to the diameter, and the number representing the ratio of the circumference of the circle to the diameter thus measured will therefore be greater than 3.14159+, which is its normal value Moreover the relative velocity decreases as the center is approached, so that the contraction of the measuring rod is less when applied to a smaller circle, and the ratio of the circumference to the diameter while still greater than the normal, will be nearer to it than before, and the smaller the circle the less the difference from the normal For circles whose centers are not at the point of zero force the confusion is still greater, since the velocities relative to the observer of points on them now change from point to point The whole scheme of geometry as we know it is thus disorganized. Rigidity becomes an unmeaning term since the standards by which alone rigidity can be tested are themselves subject to alteration These facts are expressed by the statement that the observer's measured space is non-Euclidean, that is to say, in the region under consideration measurements do not conform to the system of Euclid

The same confusion arises in regard to clocks. No two clocks will in general go at the same rate, and the same clock will alter its rate when moved about

The General Principle of Relativity

The region therefore requires a space-time geometry of its own, and be it noted that with this special geometry is associated a definite gravitational field, and if the gravitational field ceases to exist, for example if the disk were brought to rest, all the irregularities of measurement disappear and the geometry of the region becomes Euclidean This particular case illustrates the following propositions which form the basis of this part of the theory of relativity

(1) Associated with every gravitational field is a system of geometry, that is, a structure of measured space peculiar to that field.

(2) Inertial mass and gravitational mass are one and the same.

(3) Since in such regions ordinary methods of measurement fail, owing to the indefiniteness of the standards, the systems of geometry must be independent of any particular measurements

(4) The geometry of space in which no gravitational field exists is Euclidean

The connection between a gravitational field and its appropriate geometry suggested by a case in which acceleration was their common cause is thus assumed to exist from whatever cause the gravitational field arises. This of course is pure hypothesis, to be tested by experimental trial of the results derived therefrom

Gravitational fields arise in the presence of matter Matter is therefore presumed to be accompanied by a special geometry, as though it imparted some peculiar kink or twist to space which renders the methods of Euclid inapplicable, or rather we should say that the geometry of Euclid is the particular form which the more general geometry assumes when matter is either absent or so remote as to have no influence The dropping of the notion of acceleration is after all not a very violent change in point of view, since under any circumstances the observer is supposed to be unaware of the acceleration. All that he is aware of is that a gravitational field and his geometry coexist.

The prospect of constructing a system of geometry which does not depend upon measurement may not at first sight seem hopeful. Nevertheless this has been done. The system consists in defining points not by their distances from lines or planes (for this would involve measurement) but by assigning to them arbitrary numbers which serve as labels bearing no relation to measured distances, very much as a house is located in a town by its number and street If this labeling be done systematically, regard being had to the condition that the label numbers of points which are close together should differ from one another by infinitesimal amounts only, it has been found that a system of geometry can actually be worked out Perhaps this will appear less artificial when the fact is called to mind that even when standards of length are available no more can be done to render lengths of objects amenable to calculation than to assign numbers to them, and this is precisely what is done in the present case This system of labeling goes by the name of "Gaussian coördinates" after the mathematician Gauss who proposed it

It is in terms of Gaussian coördinates that physical laws must be formulated if they are to have their widest generality, and the general principle of relativity is that *all Gaussian systems are equivalent for the statement of general physical laws* For this purpose the labeling process is applied not to ordinary space but to the four dimensional space-time continuum The concept is somewhat difficult and it may easily be aggravated into impossibility by anyone who thinks that he is expected to visualize it Fortunately this is not necessary, it is merely one of these irrelevancies to which those who are unaccustomed to think in symbols are liable

It will now be seen that among physical laws the law of gravitation stands pre-eminent, for it is gravitating matter which determines the geometry, and the geometry determines the form of every other law The connection between the geometry and gravitation is the law of gravitation This law has been worked out, with the result that Newton's law of the inverse square is found to be approximate only, but so closely approximate as to account for nearly all the motions of the heavenly bodies within the limits of observation It has already been seen that departure from the Euclidean system is intensified by rapidity of motion, and the movements of these bodies are usually too slow for this departure to be manifest In the case of the planet Mercury the motion is sufficiently rapid, and an irregularity in its motion which long puzzled astronomers has been explained by the more general law.

Another deduction is that light is subject to gravitation. This has given rise to two predictions, one of which has been verified. The verification of the other is as yet uncertain, though the extreme difficulty of the necessary observations may account for this.

Since light is subject to gravitation it follows that the constancy of the velocity of light assumed in the earlier part of this paper does not obtain in a gravitational field. There is really no inconsistency. The velocity of light is constant in the absence of gravitation, a condition which unaccelerated motion implies. The special principle of relativity is therefore a limiting case of the general principle.

ALIKE from the nature of the subject, from the fact that Dr Eddington has written a rather bulky book about it, and for that matter from our remarks on the opposite page, it should be clear to the reader that Mr. Bolton has by no means exhausted or attempted to exhaust his subject. A few of the very best of the competing essays we shall print in full in subsequent issues of the SCIENTIFIC AMERICAN *and the* SCIENTIFIC AMERICAN MONTHLY, *but a few only We shall, on the other hand, print portions of and extracts from a comparatively large number. The aim will be to set before our readers everything of real value which the contest has brought out, but to use no more space in duplication than is unavoidable, and to print nothing that requires any serious editorial questioning Many of the excerpts which will thus appear will cover points which Mr Bolton leaves untouched, many will develop more fully or to better advantage points on which he leaves something to be desired in either of these respects. We shall emphasize at all times that Mr Bolton's essay is not the only thing of value that has come out of the contest, and that no reader can do justice to the relativity theories by reading it and ignoring the others In publishing other essays or parts of essays, and even in calling specific attention to the points in which they add to or improve upon Mr. Bolton's essay, we are in no sense criticising the latter, or saying anything on which a just complaint against the award of the Judges may be based* ---THE EINSTEIN EDITOR

Some Einstein Contest Personalities

By the Einstein Editor

IT IS appropriate at this time to say a word in regard to Mr Eugene Higgins, the donor of the splendid prize of $5,000 for the best essay on the Einstein Theory of Relativity, which was announced for the first time in this paper some months ago.

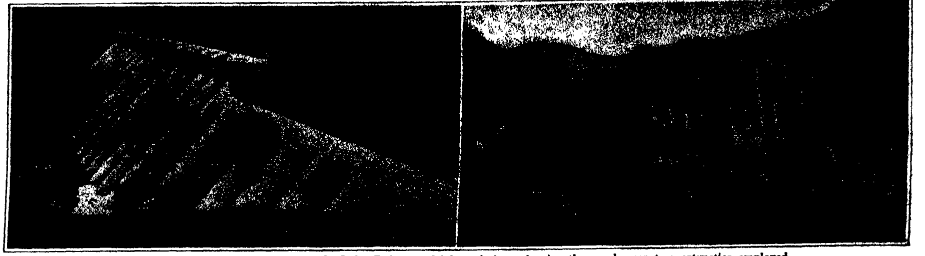
Mr Higgins is a graduate of Columbia University, was brought up in New York and lived here for many years He is a bachelor, with the freedom that all that implies, and with no special ties to keep him in this country he has traveled extensively abroad He has a handsome residence on the banks of the Seine, in the city of Paris, and makes occasional trips to this country to look after his interests here He is a gentleman of refinement and culture, interested in all that pertains to intellectual life, and particularly to physics and mathematics. It is his interest in this particular line of work which has prompted him to offer this magnificent prize for the best essay on the subject of Relativity

It has never been announced but perhaps it is appropriate at this time to state that it was Mr Higgins who some years ago offered a prize of $500 for a mathematical essay which was published in the SCIENTIFIC AMERICAN at that time It was his wish that his name should not in any way be connected with the last mentioned gift to the development of science This is in entire harmony with his character, which is one of self-effacement, it was only after considerable persuasion that he allowed his name to be used in connection with the present prize It goes without saying that he has absolutely no ulterior motive beyond his desire for the advancement of scientific knowledge in general

It is hardly necessary for us to mention to our readers the fact that these prizes have been offered by Mr Higgins without any prompting or suggestion on our part It has been thought by the Editor that it would not be proper for us to make this announcement, however, without having these facts thoroughly understood by our readers We venture to follow this attitude without the knowledge of Mr Higgins, with whom we have no opportunity of communicating as to his wishes except by cable

We regret that at the present time it is not possible for us to supplement this information about the donor of the prize with a similar statement about the winner Mr Bolton we suppose, may fairly be called unknown in a strictly scientific sense, though he is a professional man of distinction in his field He is on the staff of the British Patent Office, in a position which we are unable to define exactly at this writing but which is one of rank It will be recalled that Einstein himself was in the Swiss Patent Office for some years

That Mr Bolton did not take the prize through default of serious competition will be evident from a brief mention of a few of his most distinguished competitors Dr William H Pickering of the Harvard Observatory in Jamaica, our own Dr Russell, Royal Astronomical Society medalist for the year, and Dr William de Sitter the distinguished Netherlander, are among the astronomers of note who took part in the contest Other continental competitors were Schlick, author of "Space and Time in Contemporary Physics," and Becquerel, who should need no word of introduction Perhaps the most distinguished British name which was given up by any of the little sealed envelopes was that of H H Turner, of Oxford, others were Dr E N da C Andrade, Professor of Physics in the Ordnance College at Woolwich, and Dr T Royds, of the Kodaikanal Observatory in southern India Among American physicists we find the names of Prof H F Moore, of the University of Illinois, Dr J S Ames, of Johns Hopkins, Dr. W F Swann, of the University of Minnesota and Dr A G. Webster of Clark University Dr. G D Birkhoff, of Harvard, we should say heads the list of mathematicians pure and simple who competed, and we must list the well known meteorologist, Dr Alexander McAdie, of Harvard, an occasional contributor to our columns That even the men whose primary interest lies in the severely practical direction are not strangers to the intricacies of abstract theory is indicated by the entry of Dr C. E. K. Mees of the giant commercial photographic laboratory at Rochester. In short, Mr. Bolton has come out at the top of a very distinguished company.



Upstream and downstream views of the Lake Hodges multiple-arch dam, showing the novel concrete construction employed

The Big Dam on the Little San Diego

A Multiple-Arch Structure of Unusual Height and Some of the Principles Involved in Its Construction

By J. F. Springer

WHETHER a multiple-arch dam is the most economical one to build turns upon the local conditions. As a rule, they grow expensive as they are made tall. The reason for this needs some explanation. A single-arch dam may have a fairly vertical face upstream, but this is not permissible when there is a plurality of arches. Naturally, the water pressure must somehow be resisted. With a single arch, the sides of the canyon receive a great part of the hydraulic thrust. These sides are in fact the supports of the arch. But this is changed when one, two or more arches are to span the stream. The arches of a multiple-arch dam uniformly exert their arch action upon the foundation. In order to do this, they must lean in such way that the crest of the dam is farther downstream—on the upstream side—than is the base. A system of braces and the like sustains the system of multiple arches. This system of braces receives the arch action and transmits it to the floor of the foundation. Now these braces and the coacting uprights, etc., constitute a more and more serious problem the higher the crest of the dam is set above the base of the structure. The width of the base may equal or exceed the height of the whole dam. With dams of moderate height, the expense of the supporting framework may be rather reasonable, but when the height goes up to considerable figures the cost is apt to be considerable, too. Nevertheless, in southern California there has been built a multiple-arch dam 138 feet high. So far as I know this is the record for this type of structure.

There are 24 flutes or arches in this dam. The end ones have almost no depth, but there are a dozen intermediate ones that reach to considerable depths. The structure is of reinforced concrete. In fact, it is doubtful whether it would be practical to use another construction material. There is nothing massive about the dam. It does not depend upon its weight to resist the water, but upon the way it receives and transmits the thrust. On one side of the ravine, the bank has been leveled off for about 192 feet. This bench or ledge provides part of the spillway section for the dam, the remainder 168 feet, being a rollway over the top of one end of the concrete dam. The concrete structure fills the ravine from side to side, and is 558 feet long.

The site is inland from San Diego at a point on the San Dieguito River about 30 miles distant. Back of the dam has been created a reservoir having a capacity of some 13,000,000,000 gallons. The water impounded is to be used for irrigation purposes in the semi-arid coast lands lying between Del Mar and Oceanside and on the road connecting Los Angeles and San Diego. The rainfall is insufficient for the growth of regular crops. The dam has the duty of impounding the river water, which is then piped to desired points of use. Part of the land served is a total of some 12,000 acres whose value was less than $1 per acre. In short, the land was practically waste. Water was supplied first in 1919. One man put 28 acres in potatoes and harvested them in February, 1920. They brought when sold something over $28,000. So the land itself appears to promise well.

Not only is the dam of concrete, but a flume and pressure pipe have been constructed of the same materials. Apparently a chief factor in selecting concrete for the flume and pipe rather than wood is the desirability, or perhaps necessity, of using something that will not burn. Fires in the brush have caused a good deal of trouble, but they will naturally not do much to the concrete.

The cost of the dam, exclusive of accessory structures, has been about $4,000,000. Its site is some 10 miles from the mouth of the river. The flutes or arches are supported by 25 buttresses which are spaced at intervals of 24 feet, center to center. At the bottom the buttresses are much thicker than at upper levels. That is, at the very bottom, the thickness is 4 feet. This thickness is decreased gradually to 1½ feet at the level, 63 feet above the stream. From this level up, the thickness remains undiminished. All this is testimony to the heavy pressures that have to be resisted at the lower levels. The curvature of the arches is on a circle having a radius of 13 feet 10¼ inches. This is on the upstream face. On the downstream face, the curvature varies, especially in the lower levels, with the height above stream. However, from a level 75 feet above the bed of the stream bed on up the arches each have uniform thickness. I have said that the structure is of reinforced concrete; but this is not entirely correct. The buttresses are without reinforcement. The arches, on the contrary, are reinforced both horizontally and up and down along the slant. The reinforcement is anchored in the upstream side of the buttresses. Moreover, the reinforcement is so located in the arches as to form a kind of "fabric" near the outer and also near the inner surface. The concrete in the arches is an especially rich mixture (1 2 4), that in the buttresses is nearly as rich (1:2½ 5). The upstream face of the arches was given a coating by the use of an apparatus which throws a jet of mortar or grout.

The spillway, consisting in part of one end of the concrete dam and in part of the rock ledge, is altogether 360 feet long and is 15 feet lower than the crest of the main portion of the concrete structure. It seems that the maximum flow accurately known was a flood of 72,100 second feet. The requirement was imposed by the State that the spillway should provide for the passage of this flow. Hence the cut into the side of the ravine. A tunnel in line with the length of the dam has been constructed underneath the spillway. It is 192 feet long and 4 x 6½ feet in cross-section. It is concrete lined. Its purpose is to provide for access to the control valves underneath the dam. At its terminus, on the stream side, the tunnel connects with a series of concrete foot bridges which extend through the remainder of the dam. From these bridges in the buttresses, the blowoff and service gates may be operated. All this provision is especially for use during high water. Control might have been arranged at the crest, but then a bridge would have been needed along and over the spillway. The objection to this is that the necessary piers would cut down the capacity of the spillway to pass the 70,000 second-feet.

During the low water periods, there is access through the downstream face of the spillway for the operators, admitting to the control chamber for the irrigation supply. Here the water is turned on and off. There are half a dozen outlet gates, so set as to draw water from the lake at vertical intervals of 10 feet. Each of these gates has its individual pipe-connection with the irrigation main-conduit. These pipes are of strongly reinforced concrete and are bedded on the rock and secured to the buttresses. At the very lowest region of the dam are several blow-off valves. To reach the control device, the operator comes down a concrete stairway extending down from one of the feet bridges already mentioned.

When filled to capacity, the dam will restrain a lake 115 feet deep. The 30,000 acre-feet of water stored here is to be used at more or less distant points. There is a conduit 4½ miles long which serves to carry the water toward the coast. It consists of a ditch which has been lined with concrete. At places, the conduit is covered with concrete slabs, the object in view being to prevent the invasion of rocks rolling down the mountain side. There are a number of inverted siphons. These are used to get the water across ravines or other depressions. Some of these are, at their lower part, under a pressure corresponding to a 90-foot head—that is, to 39 pounds pressure per square inch. There is also an amount of steel flume. The steel flume and the lower parts of the concrete siphons are carried by concrete trestles. The siphons are 42 inches in diameter and are reinforced. The trestles have been constructed of pre-cast interchangeable units. It is said that the cost of the trestles was much less because of this substitution for the ordinary method which proceeds by pouring the concrete *in situ*.

Forty-two-inch concrete siphon on the San Dieguito project

The dam which impounds the water is Hodges Dam and the body of water Lake Hodges. The conduit delivers to a second lake which is known as San Dieguito Reservoir. This second lake is created by another multiple-arch dam. It is 50 feet high and [illegible] feet long. Concrete

(Continued on page [illegible])

Clearing Away the Scars of War

THE recent war, considered in an atmosphere three thousand miles away from the former battlefields, may be an old story. But to those who have had to live in the shambles of the great conflict, the war is by no means over so far as its effects are concerned.

Thanks to the courtesy of President André Tardieu of the Comité des Régions Dévastées, we are enabled to present a number of striking facts and figures concerning the gigantic task facing the French people, and what progress they have already made despite the serious limitations imposed by lack of sufficient finances, scarcity of coal, and absence of German assistance.

Of 2,728,000 persons driven out of the devasted region by the invading armies, 2,023,000 have returned. The war caused the destruction of 4,068 municipalities, of which number 4,006 have been re-established Before the war there were 6,445 schools in the devasted region; today 5,345 have been re-established. In all, 574,777 houses were either entirely destroyed or at least half destroyed. By last June the French had rebuilt 13,100 houses, repaired 178,500 houses, and erected 46,370 temporary structures. These structures afforded shelter to 887,000 inhabitants; the rest of the population in the devastated region have been living in such houses as remained undestroyed. The problem of rebuilding is a two-fold one: first, the land must be cleared away, and, secondly, the rebuilding must be carried on with such materials and labor as are available In many instances the ruins are such that it is not feasible to clear them away One cannot imagine what a destroyed town means in terms of broken stone, loose brick, piles of plaster, shattered glass, and huge, deep holes To remove such a mass of débris is often more difficult and costly than to select a new site and build a new town from the ground up.

Of arable lands, the war ruined 9,810,000 acres, of which 8,068,000 acres have been cleared of projectiles, and 6,687,000 of iron wire. The French have plowed 8,756,000 acres; 134,000,000 cubic meters of trenches have been filled in, and 182,000,000 cubic meters of iron wire networks have been cleared away

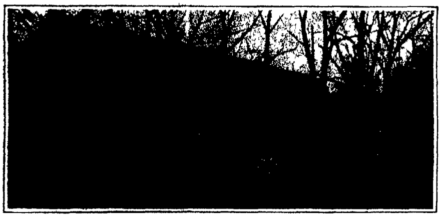
The war destroyed 1,897 miles of standard gage, and 1,483 miles of local track. Of this mileage, only 737 miles had been replaced up till last April Of the French canals, 992 miles were destroyed, and 488 miles have been repaired. The roads suffered heavily, 32,031 miles being destroyed The French have repaired 1,215 miles and improved 9,962 miles. Of factories, the war destroyed 11,500. Since the termination of hostilities the French have re-established 3,540 factories, which are now operating, and 3,812 are being rebuilt.

A New Sweet Clover Harvester

AS a soil builder sweet clover is rapidly gaining favor in all parts of the country. The great drawback to a more universal use, in one sense, has been the lack of adequate machinery to harvest the seed for planting or sowing purposes. Until lately the only way to obtain the seed was to cut the crop with a binder or mower and thresh in a clover huller, and should the residue be returned to the land it would be difficult to plow under with satisfactory results. With a new harvester invented by an Illinois man it is now possible to remove the seed and the plant is left standing to be plowed under in order thoroughly to enrich the soil.

Virtually the machine is pushed through the clover field, when in operation, by four horses, while two men operate it. One man tends to the screening and sacking while the other drives the team.

The machine is carried by two wheels while the end of the tongue is supported by a center wheel to facilitate turning at corners. A chain sprocket on the larger axle drives an overhead shaft bearing four large paddle or threshing wheels at a high speed Parting guides compact the stalks as they are drawn through a series of fin shaped paddles, some rigid, others mounted on the sides of the threshing wheels. These notched paddles mesh loosely. The stalks of the plant are stiff when the seed is ripe and upon being drawn through are bent into series of angles which hold while the seed is beaten off A draft of air drops the seed into conveyors that carry it back to a bin, where it is screened and sacked A nine foot swath is taken by the machine in the field being harvested The mechanism is easily raised or lowered as it is necessary



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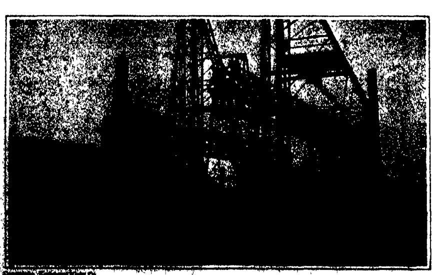
Reconstructed Verdun, showing the library and print shop. Most of the rebuilding in France is in the form of frame construction

All these logs represent but one Douglas fir tree, a species that often attains a height of 250 to 300 feet

This machine strips the clover plants of the seed but leaves the plant standing



New system of unloading coal recently installed on barges in San Francisco Harbor

Scientific American Monthly for February

"ONLY the other day some dull and tedious occupant of a professor's chair solemnly remarked that the metrologist must be compared to the plowhorse, patiently digging his furrow, while the man of new and original ideas is the race-horse, swiftly covering space to the plaudits of an admiring crowd The metaphor is not entirely displeasing to me, for when once the race is over, what is there to show for it, but a little dust and a little noise, while in the furrow traced by the steady plowhorse, the coming harvest will tomorrow lift its head" Thus spake M. Charles Edouard Guillaume, winner of the Nobel Prize for Physics, in an interview for the SCIENTIFIC AMERICAN MONTHLY. M Guillaume is the director of the International Bureau of Weights and Measures, located at St Cloud The article proceeds to describe the interesting apparatus developed and employed at that famous Bureau

Fifteen years ago Vesuvius blew off its head in a very violent eruption Since then it has been gradually building up a new cone on the floor of the old crater The process has been studied by Frank A Perret, the well known volcanologist, and he explains this bit of volcanic archi

(Continued on page 120)

A Tree to the Train Load

DOUGLAS fir is the name given to one of the finest timber trees in the western part of the United States And it doesn't require more than one tree to make a train load, when one is dealing with Douglas fir

Proof of this is found in the accompanying illustration which shows such a tree cut into car lengths for convenience of transportation The diameter of the log in the foreground is 10 feet 7 inches That is by no means an extraordinary growth, for specimens with a diameter of 15 feet are common, and travelers in the belt where they grow report having seen them 20 feet in diameter and tapering straight to a height of from 250 to 300 feet

The Coast Range of the Sierras provides the best trees. Only the famous redwood and two or three other growths exceed the fir in size, and none except the yellow pine produces so much commercial timber The treo is sometimes styled the Oregon pine, but foresters say it is more of a hemlock Its botanical name is "false hemlock," although that designation is not generally approved

Doing Away with Hand Shoveling

THE equipment shown in the accompanying illustration has recently been installed on some barges at San Francisco, for the purpose of doing away with hand shoveling. The shape and size of the bottom of each barge are such that the clam-shell bucket can pick up every bushel of coal without the necessity of employing any men for hand shoveling When the bucket is filled with coal, it is raised to the overhead truck and carried to the center of the barge Here the coal is dropped into a hopper From the latter the coal is delivered into a skip which is attached to a cable and adapted to be elevated by the cable to a great height where it is automatically dumped into a spout which delivers the coal into the bunkers of the ship.

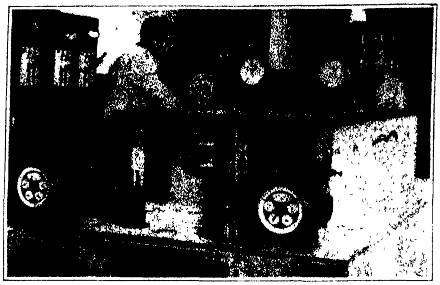
Artificial Ammonia

The Claude Process, Now in Successful Operation in France

By Jacques Boyer

THE creator of the French liquid air industry, M. Georges Claude, has just made a new and important discovery in the industrial synthesis of ammonia. The accompanying pictures show that the method requires neither complicated apparatus nor vast installations. In spite of this the inventor deals with pressures of several hundred atmospheres in order to unite nitrogen with hydrogen, pressures which artillerists alone were handling up to now in guns of heavy caliber.

M. Claude began first by studying in his laboratory the various catalyzers which by the simple action of their presence will lead to combination of the heavily compressed and heated gases. These catalyzing substances (which M. Claude keeps a secret) are put in steel tubes placed in strong cement vats. By means of gages, recording meters and pyrometers, it is possible to watch over the reactions of the gaseous mixtures and to determine the proportions as well as the nature of the elements to be used in the industrial apparatus. Ingenious devices facilitate besides, the cooling of the tubes containing the catalyzing substances.



The laboratory room from which, with the aid of the manometers and pyrometers shown, the processes of combining the hydrogen and nitrogen into ammonia are controlled

If one visits the factory, one sees on one side a column for the production of nitrogen extracted from the air by the liquefying process. The functioning of this apparatus is based, as is well known, upon the accumulation of cold resulting from a series of successive discharges of the compressed gas.

Elsewhere, hydrogen electrolytically produced is obtained. When this is done the gaseous mixture of nitrogen and hydrogen is prepared in advance, great care is taken to rid this mixture of all traces of oxygen before it is allowed to pass in contact with the catalyzing matter. It is then hypercompressed at 1,000 atmospheres and metallic gages measure this pressure which is constantly maintained by regulating the admission to the hypercompressor. The small gaseous admission is regulated by means of a regulating valve placed below the tube and the percentage of ammonia is determined by allowing the outflowing gases to pass through a sulfuric solution and then through a gas meter.

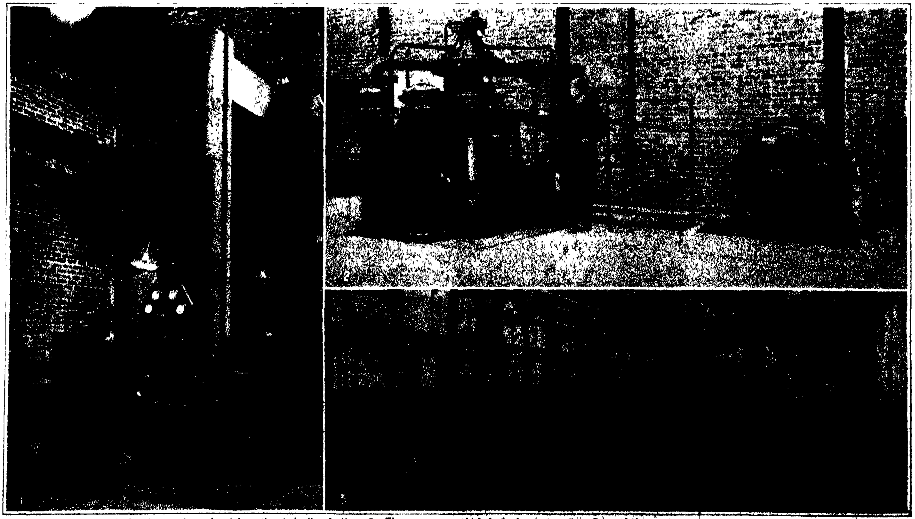
In order to avoid a possible explosion, the tube containing the catalyzer and in which the synthesis of ammonia is effected, is put in a concrete well outside the buildings. Each catalyzing tube is 2½ meters long, 2 centimeters thick and has an inside diameter of 0.018 meters. Once it is started, the reaction continues without any difficulties. What is remarkable, is that these enormous pressures can easily be handled. The apparatus does not allow the escape of any noxious vapors in the air of the room; the joints of the hypercompressor remain tight and tiny tubes suffice to hold considerable masses of gas. The liquefied ammonia is gathered in steel tubes and the ammoniacal dissolutions, more or less concentrated, are put in glass containers.

What distinguishes the Georges Claude method of synthetic manufacture of ammonia, from the process invented by the German Haber, is the incontestable superiority of its yield. With an equal volume, the Claude catalyzing tubes produce 25 times as much as the colossal installations at Oppau (near Ludvigshafen) and at Merseburg (near Halle) in which the Boche chemist carries on his manufacture.

The capital importance of this new-born industry can be seen at a glance. The production of synthetic ammonia by means of nitrogen from the inexhaustible air and electrolytic hydrogen assures to France in war times the possibility of manufacturing without limit the explosives necessary for her defence, and in peace time, allows her to obtain cheaply sulfate of ammonia, the fertilizer so necessary for the development of her agriculture.

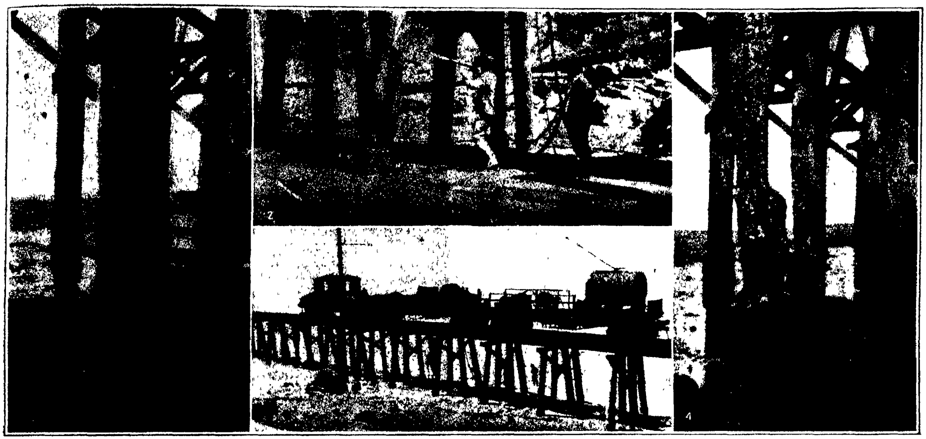
Kaolin

BESIDES its most familiar use in pottery, kaolin finds application in the paper industry as a filler. This clay is obtained by washing kaolin in long troughs under conditions which permit that portion best suited for ceramics to float off, while the heavier particles, which go to the paper trade, sink to the bottom. About two parts of kaolin suitable for paper filler are obtained from three parts of raw material



1. The column in which the nitrogen is produced from the air by liquefaction. 2. The compressor which feeds the air into the column of the previous view. 3. The huge scale on which the process may be carried out is indicated by the magnitude of these electrolytic separators that supply the hydrogen

The apparatus with which M. Claude obtains hydrogen and nitrogen for the manufacture of ammonia



1. Pile after treatment, reinforced with chicken wire and built out ten inches to its original size, protection is now absolute 2 The dry sand-and-cement mixture is forced through a fine spray of water, gathering moisture for cementing at the point of contact 3 The flat cars that supply ammunition for the cement gun 4 Condition of a pile after four years struggle with the limnoria—the same pile shown after treatment in the first view

How piles are protected against the wood borer by use of the cement gun

The Wood Borer Takes the Count

HOW to protect piling, when driven in salt water, from the attacks of the teredo, limnoria and other wood borers has been a problem for years The cement gun is the answer It has been proven that by "shooting" a mixture of three parts sand to one part cement into the pile on all sides a covering completely impervious to water is obtained—one which does not break off, resists chemical action, and entirely prevents the entrance of all forms of animal life

When the traction company undertook the survey of its electric road skirting the shores of Puget Sound between Bellingham and Mt Vernon, Wash, it faced a two-horned dilemma in the first place It was either an expensive rock cut along the face of the mountain or a four-mile trestle across the tide flats, a combat with earth and rock slides on land or the depredations of wood borers in the water Terra firma was first chosen, but after a few weeks' work, during which time enough débris rolled down upon the railroad track below to give warnings of perpetual trouble, this plan was given up and the company "went to sea"

The trestle was driven in 1911 At the end of four years the attacks of limnoria had become so serious as to require drastic treatment and the erection of fortifications began. It might be mentioned that there is a difference between the limnoria and teredo, the two most destructive agents The former feeds on the wood while the latter enters it only for the purpose of making a home. Limnoria completely destroy the pile, eating it out in a cone shape, while the teredo honeycomb it, leaving the shell intact Limnoria are never found below the mud line, but usually stay some 18 inches above it, whereas the teredo is usually found higher up.

At first a short iron casing was placed around the base of the pile extending nine inches above and below mud line. This was used as a form and filled with cement, making a coating about one inch thick. The pile was then given a brush treatment with a one-to-one sand and cement mixture which covered all that portion below the high water line. The precautions were only partially successful, however, and the work of destruction continued.

By way of experiment, hydrated lime was in some cases used in the cement mixture, the idea being that it would pour inside the casing better; but the action of salt water very soon completely disintegrated the cement mixed in this way. Where lime was not used it stood up better, but was not water tight and pieces flaked off Engineers then cast about for some method of forcing cement into the pile instead of pouring it around the outside. Enter the cement gun

The gun itself however, is only a part of the equipment needed, two flat cars being required to accommodate the entire plant One of them carries a large water-supply tank with a smaller 100-gallon pressure tank and an air compressor, while the other carries the cement mixer and raw materials The cement gun proper, which is operated by a ground man underneath the trestle, is supplied by two lines of hose, one from the mixer and the other from the pressure tank A dry mixture of three parts sand to one of cement is forced through one hose and water is forced through the other The two streams join at the nozzle of the gun, where the solid particles are driven through a fine mist or spray and the moistened sand and cement penetrate the pile The operator is able to control the supply of water with a hand lever Under ordinary circumstances, the drier the mixture the better the results The mixture is dashed against the piling with such force that when hardened it is impossible to make an indentation with a knife All the voids are filled Where piles were badly eaten away they were reinforced with chicken wire before treatment, and often built out to a thickness of from eight to twelve inches

Experiment shows that the application of this treatment to partially destroyed piling does not strengthen it but merely affords protection This fact was ascertained by a test made with two cedar sticks 13 inches in diameter by three feet long One was left in its natural state and the other cut so as to resemble a pile attacked by limnoria and then built up with the cement gun

The trestle where the cement gun was used contains approximately 5,700 piles of which 5,200 were treated, the others being above water line Costs vary according to local conditions and the amount of damage to be repaired In the case here discussed, it was possible only to work at low tide and it was frequently necessary to clear the track for regular traffic, which delayed the work and added to its cost The best estimates available show an expenditure of from 30 to 35 cents per lineal foot for the treatment

The next step will be to treat the piles before they are driven, and laboratory tests indicate that this can be readily accomplished The piles will be placed on rollers, thoroughly wet, and then sprayed to get a quarter-inch to a half-inch coating When so treated the cement can only be flaked off with a sledge hammer and cold chisel and the cost will of course be much less

Floating into place the 208-foot span in the new bridge at Washington

A New Idea in Placing a Big Span

THE high tide of turbulent waters, so frequently destructive, is occasionally an ally in accomplishing an engineering feat A notable instance is the recent undertaking in Washington, D C, in the placing of the initial steel span for a new bridge over the Potomac River

The span 208 feet long and weighing approximately 200 tons, was built on a float and lifted into place by a swelling morning tide The superfluous structure was displaced at low tide during the afternoon of the same day

The magnificent viaduct displaces the historic, antiquated Georgetown bridge The completed structure rears itself 72 feet above mean water level, which is the height of the clearance arch The roadway is 84 feet above mean water level The solid footings which formed the basis for the floats, located on the piers will serve as the resting place for the finished viaduct

The Heavens in February, 1921

The Diameter of Betelgeuse—How It Was Measured and What It Means

By Prof. Henry Norris Russell, Ph.D.

PUBLIC attention has been widely and deservedly attracted during the past month to a notable achievement of observational astronomy—no less an advance than the actual measurement of the diameter of a fixed star

From the days of the first astrologers till now, the stars have shown themselves to us merely as points of light —more resembling the "mathematical point" than do any other natural objects. To the naked eye they are dots on the expanse of heaven; and viewed with our greatest telescopes they remain dots still—dazzlingly bright, perhaps, but without perceptible size With a high magnifying power, it is true, all stars appear as minute disks, but the size of these disks depends, not on the star, but on the telescope They are mere optical effects, inevitably produced by the influence, upon the waves of light, of the circular aperture through which the light enters the telescope, and forming, as it were, an image of this aperture, and not of anything in the heavens above

The greater the aperture of the telescope the smaller will be this "diffraction pattern", but even with the largest instruments, it remains of such a size as to conceal from us those fine details which often we would most desire to observe—such as the existence of very close double stars, and, in particular, the actual disks of the stars themselves But Professor Michelson, by a brilliant application of the interferometer, has added the solution of this problem to the large list of scientific advances which this apparatus has permitted A fuller account of this matter is given in the SCIENTIFIC AMERICAN MONTHLY for February, by the present writer, and will be found of interest to those who wish to understand the process in greater detail than is here given

The Michelson Apparatus

The principle of the apparatus is simple enough A diaphragm is placed in front of the telescope so that light is admitted to it only through two parallel slits, which may be at any distance apart, up to the full diameter of the objective. The beams of light which enter these slits are brought to a focus at the same point, where the ordinary star-image would be. At the center of this image the two beams, which have traversed exactly the same distance in coming from the two slits, arrive in such fashion that the two sets of light waves reinforce one another But at a short distance on either side a point can be found where the light from one slit arrives sooner than that from the other, in such a way that the light waves from the two slits are out of step with one another, and "interfere" so as practically to destroy one another At a point farther out, one stream of light has gained a whole wave length on the other, and reinforcement again takes place, and this sequence is repeated again and again, so that the neighborhood of the focal image is occupied by a series of fine bright and dark bands or "fringes," parallel to the length of the slits

If there is a second star close to the first, the light will form another independent system of fringes, superposed on the first set, and if the bright bands of the one system fall on the dark bands of the other, the general effect will be to obliterate both—completely if the two stars are equally bright, partially if they are unequal

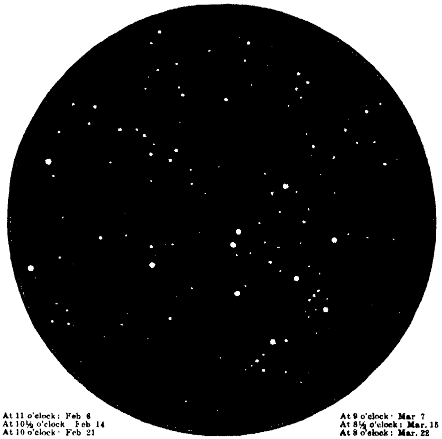
The importance of this lies in the fact that these fringes are very narrow—less than half as wide as the round star-images formed when the aperture of the telescope is entirely clear. If these two stars are so close together that their ordinary telescopic images overlap, and are superposed, the two sets of fringes may nevertheless be displaced relatively to one another by an amount great enough to cause a disappearance, or at least a serious loss, of "visibility," and in this way the duplicity of the star may be revealed, as was done a year ago with great success in the case of Capella

The new apparatus does not indefinitely increase the "resolving power" of the telescope, but it rather more than doubles it. What is even more important, it is found by observation—much to the astonishment of experienced astronomers—that the "bad seeing" due to disturbances in the earth's atmosphere, which does such very serious damage to the definition of the images formed by great instruments, affects the interferometer to a very much smaller degree, so that, on poor nights when the telescopic images seen directly are diffused and trembling, and all the fine details are lost, the fringes are still easily visible, and can be well observed

Measuring Star Diameters

The interferometer can be used to measure the diameter of a small luminous disk, as well as the separation of a close double star. In this latter case the two sides of the disk play the same part that the two isolated stars did before, and, for a proper separation of the slits, the fringe systems formed by the light from the opposite sides of the star-disk will be superposed and obliterate one another.

It requires a much larger instrument to measure the diameter of a disk than the distance of a pair of double stars whose separation is equal to the disk's diameter; for it is the distance between the middle points (so to speak) of the two semicircular halves of the disk, and not the distance between their remotest outer edges, that the instrument really measures. But even so, the interferometer once more, in this case, greatly increases the power of the telescope to which it is applied. A further gain is possible, for, as Michelson has done at Mount Wilson, a long beam with a carefully planed flat surface may be placed across the outer end of the telescope, at right angles. Two mirrors, which can be set along this beam at any desired distance from the center, receive the star's light and reflect it inward to a second fixed pair of mirrors, which send it down to the two slits already described, and so into the telescope With this arrangement, the effective distance between the slits becomes equal to the distance which separates the outer mirrors, and the gain in resolving power is proportionate.



At 11 o'clock: Feb 6
At 10½ o'clock Feb 14
At 10 o'clock: Feb 21

At 9 o'clock: Mar 7
At 8½ o'clock: Mar. 15
At 8 o'clock: Mar. 22

At 9½ o'clock: March 1

NIGHT SKY: FEBRUARY AND MARCH

The apparatus which has just been put into use at Mount Wilson, as an attachment to the 100-inch telescope, permits of a maximum separation of twenty feet between the mirrors. This gives a resolving power equal to that which would be obtained by direct vision with a telescope 40 feet in diameter, so that the instrument is incomparably more powerful than anything that has ever before been pointed at the stars.

With the mirrors at their widest separation, white stars—even the brightest, like Sirius and Procyon—still show sharp fringes, which indicate that the apparent diameters of the real disks of these stars are too small to measure, even with the great advance in instrumental power. But with bright red stars the case is different. Observations on Alpha Orionis (Betelgeuse) showed a marked decrease in the visibility of the fringes when the mirrors were eight feet apart; and when the distance was increased to ten feet the fringes vanished. From this it may be calculated that the angular diameter of the star is about 0.045 second of arc. Further measure, giving a more precise determination, will probably soon be made. Meanwhile it is well to consider what this announcement means.

The Case of Betelgeuse

One twenty-second part of a second of arc is a small quantity indeed. It corresponds to the apparent angular diameter of a disk (or of course of a sphere) one foot in diameter and 850 miles distant. That it should be possible to measure anything so small is in itself amazing.

But when we come to turn this angular measure into miles, the results are even more startling, and this time by their greatness The parallax and distance of Betelgeuse are not yet known with any great degree of precision, for the star is very remote, and its parallax so small that even the best measures are affected by a large percentage of error. From the existing material (which will doubtless be supplemented by additional observations within the next few years) it appears that the parallax is probably about 0.012 or 0.015 seconds, and the star's distance some 200 or 250 light-years. But the parallax measures the angle that would be subtended by the line joining earth and sun, if removed to the star's distance. It follows that the diameter of Betelgeuse is probably fully three times as great as the earth's distance from the sun—in round numbers, about 300,000,000 miles, fully as big as the whole orbit of Mars, and much bigger than that of the earth. This conclusion has, very naturally, produced a great impression upon the whole educated public

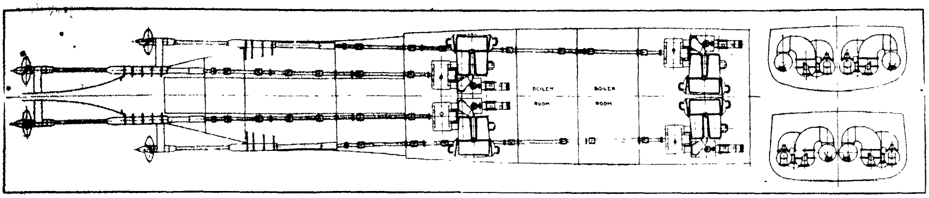
The professional astronomer was perhaps better prepared for the announcement. It has long been realised that those stars which are very luminous and yet very red, and which presumably give out relatively little light per square mile of surface, must be very large. Various astronomers, among them Eddington in England and the present writer in this country, have called attention to this, and even gone so far as to publish approximate predictions of the diameters of such stars —predictions which, in the writer's case, appear to be about two-thirds of the actual value.

The direct confirmation of the existence of these giant stars is however of the utmost interest and importance, and will be welcomed more enthusiastically by none than by those who find their own theoretical studies confirmed—and superseded—by these observations.

The Heavens

The southeastern and southwestern heavens now vie with one another, the latter having the preponderance of bright stars, but the former boasting the presence of Jupiter and Saturn, which partially at least restore the balance. Orion is well up in the southwest, with the giant Betelgeuse uppermost, the white stars of [illegible] below, and the brilliant [illegible] [illegible] still. Aldebaran is on the right, with the Pleiades beyond, and Sirius on the left. Procyon is [illegible] [illegible], and Castor and Pollux above Orion and almost overhead.

(Continued on page [illegible])



Plan and cross-sections through the engine rooms of the new 7,500-ton, 35-knot U. S. Scouts

The Motive Power of the New 35-Knot Scout Cruiser

THE new U. S. light cruisers now under construction, an illustrated description of which was published in our issue of January 15, 1921, will be the most effective scouting vessels ever built by any nation. They will be swift enough to outrun anything afloat; large enough to keep their speed in heavy seas, roomy enough to rush detachments of marines to "trouble spots"; and powerful enough to overwhelm destroyers and other light craft.

Interesting as these vessels are as naval units, they are perhaps even more so from the standpoint of steam engineering, since each is to be driven by geared turbines having a total capacity of 90,000 horsepower. Never before has so large an amount of power been installed in so small a space, and in consequence the performance of these vessels will be carefully followed by engineers and naval men all over the world.

Each ship has four 22,500 horsepower cross-compound Westinghouse turbines, and each turbine is geared to a propeller. The turbines for the two center propellers are placed together in an engine room located well aft, and the turbines for the wing propellers are placed in a second engine room farther forward, with the boiler rooms between the two engine rooms

Each turbine consists of a high-pressure and a low-pressure element which drive the propeller through a common gear. The high-pressure element consists of two rows of impulse blading followed by reaction blading A special belt of this reaction blading is used only when running at low speeds and is by-passed for operation at higher speeds The low-pressure element, which normally receives steam from the high-pressure element and discharges it into the condenser, has reaction blading only. Both elements are rated at 11,250 horsepower each, and either can be used independently in case the other is out of service for any reason.

An astern turbine, consisting of two rows of impulse blading, is incorporated in each low-pressure element. When supplied with the same amount of steam as for full ahead operation, the astern turbines can develop 80 per cent of the full ahead power and can drive the ship at about 20 knots

The reduction gears are of the Westinghouse floating frame type. Each has two pinions, one for the high-pressure and one for the low-pressure rotors, and a single gear wheel connected to the propeller shaft The speed reduction ratio is about 7 to 1 and is effected in a single step.

The main turbines can propel the ship at speeds ranging from 12 to 35 knots, but as only a relatively small amount of power is needed for low speeds, small auxiliary turbines are used for cruising purposes. There are four of these cruising turbines per ship and each consists of a single-row impulse wheel and can develop 420 shaft horsepower at 6000 revolutions per minute Each cruising turbine is mounted on an extension of the case of a main high pressure element and can be coupled to the high-pressure rotor through a gear giving a speed reduction of about 6 to 1 The mechanical line-up is therefore cruising turbine, cruising gear, coupling, main high pressure rotor, main low-pressure rotor, main gear, propeller shaft The steam first passes through the impulse blades of the cruising turbine, then through the reaction blades of the cruising belt of the main high-pressure element, then through the remaining reaction blading of both elements, and finally into the condenser With this arrangement a maximum power of 1,000 horsepower can be obtained from each of the four turbines The cruising speeds range from 12 to 15 knots with excellent steam economy over the entire range.

The coupling that connects the cruising turbine with the rotor of the main turbine is operated by means of a hand lever To connect a cruising turbine when the main turbine is in operation, the former is brought up to speed and the latter slowed down until a synchronising device indicates that the two are operating at the same speed, when the connection can be made with safety.

Special care is taken to prevent the cruising turbines from over-speeding either when operating under their own power or when accidentally left connected to the main turbines and driven by them A fly-ball governor controls the throttle to each cruising turbine and also, through a relay, the governor valve of the main turbine If the cruising turbine operates at 10 per cent over speed, this governor cuts off the steam to both turbines If this governor should fail to operate at 12 per cent over speed, an emergency stop cuts off the steam to the cruising turbine, and disconnects the coupling

Water Injection in Gasoline Engines

THE practice of injecting water in conjunction with the fuel is quite common in kerosene engines, the *object being to keep down the cylinder temperature* under conditions of heavy loading and prevent preignition In fact, it seems very difficult to operate an Otto cycle *kerosene engine* and get *satisfactory results* without water injection. There also has been considerable experimentation with water injection (or induction) in gasoline engines, by makers of fuel conditioners and their customers, who believe that the injection of water will lessen or eliminate the formation of carbon deposit and increase the fuel economy

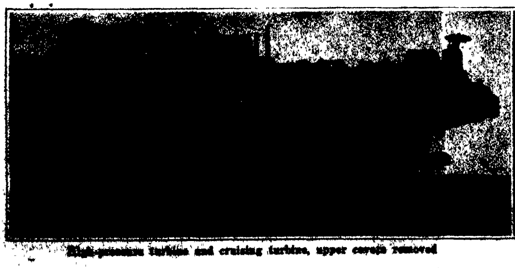
In the development of aircraft engines, the suggestion was made that if water injection had these effects it should be beneficial in aircraft work The problem was assigned by the National Advisory Committee for Aeronautics to the Bureau of Sandards, and an extended investigation was made The tests were carried out on a Class B military truck engine, and also on a Rutenber 6 cylinder, 3 x 5 in engine, which operated at high jacket temperature Although the investigation was made at the instigation of the Aircraft Department, the tests were conducted on a truck and an automobile engine, but the results, of course, are of general application

The results arrived at have been summarized by the experts of the Bureau of Standards somewhat as follows No appreciable effect is produced upon the power, fuel economy and general operation of a gasoline engine by the injection of water into the cylinders at rates varying from 0.03 to 0.44 lb per brake horsepower-hour When water is injected at a higher rate than 0.44 lb per brake horsepower-hour there is an appreciable decrease in the power output fuel economy and smoothness of operation It is quite probable that in a badly carbonized engine, or an engine of defective design, in which there are hot spots that cause preignition, the injection of the water results in an increase of power In an engine operating at high waterjacket temperature the injection of water in amounts between 2 and 8 lb per hour produce a softening and slight reduction of carbon, this reduction not exceeding 25 per cent and being most noticeable in the piston heads and valves However, water injection at the maximum rate also causes a considerable reduction of power

Photographs That Educate While They Entertain

A LIVELY bathing scene in which the pool is a dew drop and the bathers are creatures too small for the naked eye is shown in one of the recent motion picture releases by the United States Department of Agriculture The new film, known as "A Plant Disease and How It Spreads,' was photographed under the *supervision of scientists in the* Bureau of Plant Industry The pictures, most of which were taken through a microscope, deal with the organisms that cause rhubarb blight *and result in heavy loss in truck-farming* sections Field scenes also are included Symptoms showing the existence of the blight, the extent of damage wrought, *and methods of eradication are depicted* in the film, which will be distributed through department channels

The new "movie" is one of the few that have been photographed largely through a microscope, and because of that fact is expected to attract added attention It is designed for both scientific and popular use, and is expected to be much in demand among educational institutions The department has more than 500 films in circulation, showing over 115 subjects They have proved of marked value in extending the work of the department

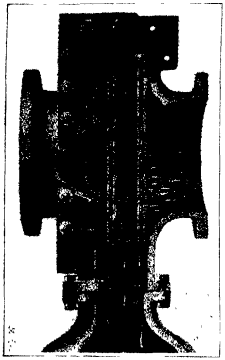


High-pressure turbine and cruising turbine, upper casing removed

Pinions and gear wheels of the reduction gear

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Broken away view of a device which separates oil from exhaust steam

Separating Oil from Exhaust Steam

WHILE the oil-separating device shown in the above illustration has been in use for some years past it continues to hold the field because of its efficient work The features of the device, which is shown partly broken away, are as follows

The shell and baffle plates are of cast iron These multiple baffle plates are of special staggered grid construction and are so designed as to ensure the removal of all oil from the exhaust steam before it leaves the separator The oil after being deposited on the saw-tooth grids, enters a duct inside of the grid bars and flows through this duct to the large receiver reservoir at the bottom This feature prevents steam from picking up the oil again after it has been deposited on the baffle plate

The separator is said to fulfill one of the most important requirements of an efficient oil separator It is apparent that if an oil separator is efficient the separation cannot be accomplished without the baffle plate surfaces becoming gummed with oil and grease, and also that this coating reduces the separating efficiency It is, therefore, essential that an oil separator be so constructed as to be easily cleaned. The baffle plates in this separator are removable through an opening provided and may be taken out and cleaned in a lye solution and returned to the separator ready for another period of service

This cover slips over the milk bottle, keeps milk clean and facilitates pouring

A Better Hood for the Electric Welder

ONE of those simple improvements designed to facilitate a given task takes the form of a new helmet for men engaged in electric welding operations The body of the helmet is made of chrome leather, which has been treated so as to make it impervious to water and the injurious rays which accompany welding operations The helmet is provided with a window of chemically prepared glass which protects the eyes from the ultra-violet rays

Now the main improvement which this mask or helmet represents over the usual type is in the mounting of the window, which is such as to permit it to be raised with the left hand of the operator as shown in our illustration In this manner the operator can view his work without the intervening dark screen yet let the screen fall back in place when ready to go ahead with further welding operations Obviously, this helmet saves much time, for ordinarily a welder would remove his helmet in order better to see the finer details of his work

Copyright, Keystone View Co

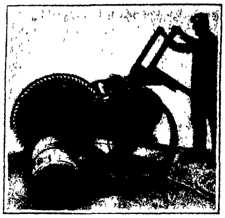
A twist of the left hand lifts the protective screen out of the way in this new welding helmet

A Cover for the Milk Bottle

A RECENTLY patented milk bottle cap made of aluminum, is a device that has two improvements First, it has a hole in the top, opposite to which is a lip, so that milk can be readily poured into a glass or cup When not wanted for pouring, a tight cover slips back over the hole out of which the milk has been poured Much time can be saved with this cover, for it is not necessary to remove the cap to get at the milk Again, the milk in such a bottle is not exposed to dust or the air

A Circular Saw-of-All-Work

WE illustrate herewith a universal circular saw of interesting design. It will be seen that it is mounted on a carriage that makes it possible to bring it to the work in any conceivable position The photographer has tried to indicate the extraordinary range of applicability of the saw by showing it at work on a rather unusual job of cutting off a barrel This is but a suggestion of the uses to which this ingenious device can be put It is operated electrically as indicated by the presence of wire and motor in the picture, the consumption of current is said to be extremely moderate



The saw for a thousand jobs, and one that goes to its jobs

A Partnership of the Fork and Knife

A LOGICAL development of the great war is the one hand knife and fork utensil which is shown in the accompanying illustration With this combination knife and fork a person with but one hand can cut meat and feed himself surprisingly well The knife is in the form of a steel blade with a curved cutting edge, and with a number of prongs at the end to serve as the fork For cutting the meat the curved edge is placed on the meat and the blade is moved back and forth Of course, the cutting edge must be keen in order to work satisfactorily

A combination knife and fork for the one-hand man, shown in the act of cutting

Crayons That Blend

THE problem of perfecting wax crayons so that their colors will blend while being applied has been solved by Prof Katherine Lewers of the University of Nevada by the use of a solvent, such as kerosene, applied as a wash to the back of the paper Since this wash evaporates slowly, rewetting is unnecessary for an hour or more

Thus, by the mere process of overlaying and rubbing in, a few crayons of standard colors will be sufficient to obtain any delicate shade.

Whether wax painting shall regain its original prestige as an art medium, its use in the schools, where a dry medium is much to be preferred to a wet and where numberless changes must be made, is of first importance in teaching color appreciation

Briqueting Outfits for the Household

NEED we again repeat that coal, and for that matter fuel in general, is at a premium throughout Europe? Hence these columns have depicted and described almost no end of fuel-saving devices during the past few years, and we have one more device to add to our published collection, in the form of a household briqueting outfit.

This briqueting outfit is a French device which is meeting with considerable favor. It consists of a stand, a simple plunger, and a set of simple molds The material to be briqueted is placed in the mold, and then, with several sharp tamps with the plunger, a briquet is formed. The briquets may be made in the form of balls or disks, according to conditions.

A few sharp tamps with the plunger produces briquets for the household

Recent Patent Decisions

Joint Inventions.—This is an appeal from an award of priority to appellees Hope & Lambert for an invention relating to an apparatus for drying wood veneer, consisting of a rectangular housing for the material to be dried

A single count of the issue is set forth as follows "A dry kiln comprising a rectangular shaped housing, a radiator located in one end of said housing forming an end way thereof and provided with openings through which air may be drawn, the opposite end of said housing closed by an end wall, and an exhaust fan connecting with the interior of said housing through said wall"

It appears that Hope and Lambert filed a joint application November 29, 1915, and thereafter Lambert filed an individual application on May 8, 1916, which inadvertently went to patent June 5, 1917, while the joint application was copending The decision of the lower court is affirmed, and the following point of law adduced Where a joint application for a patent was filed, and later one of the applicants filed an individual application which inadvertently went to patent while the joint application was copending, the individual applicant gained nothing by the issue of the patent to him —*Lambert v Hope et al* *U S C C A of D C*

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Stopping the Chimney Thief

(Continued from page 101)

a definite weight of fuel will require a definite weight of oxygen supplied by the air Each atom of carbon will unite with two atoms of oxygen to form carbon dioxide (CO_2) and each two atoms of hydrogen will require one atom of oxygen to form water vapor (H_2O) Varying proportions of carbon and hydrogen in the fuel will call for different proportions of oxygen, hence the exact amount of air required cannot be specified until the chemical composition of the fuel is known Few fuels however require over sixteen pounds of air for every pound of fuel burned, and some need no more than 10 pounds of air per pound of fuel These proportions provide a slight excess of air over the amount indicated by chemical theory Whatever the ideal proportion of air to fuel may be, it is important to keep as close to it as possible, for reasons that will be explained shortly As there is no simple way of metering the fuel and air while they are being united chemically it may appear that this problem presents extreme difficulties Such, however, is not the case for continuous examination of the flue gases furnishes a means of keeping tabs on the proportioning of air and fuel

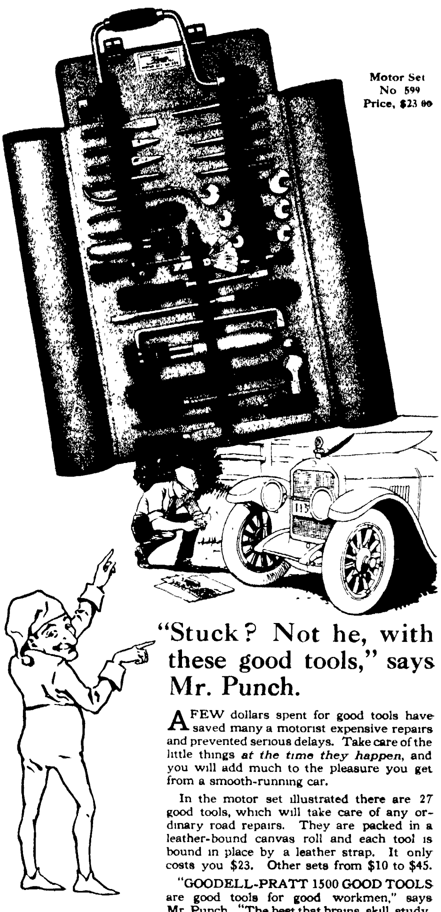
The problem of efficient combustion then is not so much one of knowing how to shovel coal or operate oil valves but is primarily one of always regulating both fuel and air supply simultaneously so that the ratio of air to fuel will always be uniform After the correct ratio is established, the fuel may burn fast or slow according to the demands for steam but by modern means of control can be made always to combine in whatever ratio is found to represent best economy

It is not generally realized that more air than any other substance is used up in a power plant—by weight about 16 tons of air and by volume over 400,000 cubic feet of air to every ton of coal It is not easy to realize just what these figures mean, so they will be expressed in another way If this air flowed into the furnace through a square conduit 1 foot high and 1 foot wide the conduit would have to be over 75 miles long in order to contain enough air to burn just one ton of coal This shows quite impressively the importance of the air supply Expressed differently, all the air, from earth to sky, above a square inch of the earth's surface weighs 14 7 pounds, hence would be scarcely sufficient to burn a pound of coal

If less air than this is supplied then some of the fuel will pass up the chimney as unburnt gases or smoke That of course also represents a loss It is seldom however that too little air is supplied, the reverse condition being almost invariably the case The greater the excess air the more heat will escape up the chimney because all air whose oxygen does not combine chemically with the fuel absorbs heat from the fire and carries it away through the stack without allowing it to do useful work such as heating water or making steam It makes little difference whether this excess air leaks in above the fire through the boiler sides or ends, or enters through the fire or ash-pit doors. If the correct air-fuel ratio is exceeded, a needless loss of fuel is bound to result, just as in the example of the grate fire previously mentioned

Fortunately we have in the flue gases an excellent source of information as to just what the excess of air amounts to A given volume of oxygen unites with carbon to form exactly the same volume of carbon dioxide For example, one cubic foot of oxygen will form one cubic foot of carbon dioxide as it combines with the carbon in the fuel. Air contains 21 per cent by volume of oxygen. If the flue gases contained 21 per cent of carbon dioxide we would know that all the oxygen had been used to burn up carbon, but that would represent perfection which is

(Continued on page 117)



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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of General Interest

BOTTLE CAP —E G BAUM, 21 W. Central St, Natick, Mass This invention contemplates the production of a thoroughly sanitary leakproof closure applicable to any standard milk bottle An important feature of the closure is the multiplicity of points at which it seals itself to the mouth when applied, thereby insuring the consumer of a germ proof package

RINSE TUB —P O VANATTER, c/o V of Ga Athens, Ga An object of this invention is to provide a tub which is divided into compartments and which has rotary mounting so that each of the compartments can be brought into convenient operative position by simply turning the tub A further object is to provide each compartment with a drain pipe

DISPLAY FIXTURE —L SHOGRAN, 850 Grace St, Chicago Ill Among the objects of the invention is to provide a display fixture adapted to support articles of varying sizes A further object is to provide a fixture which can be instantly adjusted and is adapted to firmly hold ordinary supporting plates of various sizes without altering the plates in any way or boring holes therethrough

STATIONERY —A CALCANO, Caracas, Venezuela This invention has for its object to provide a combined envelop and inclosure, formed from a single blank having lines of partial separation and lines of adhesive for permitting the sheet to be folded into a letter and an envelop for the letter The sheet is so arranged that the letter may be written by hand or on a typewriter, as desired

STRAW DISPENSER —C H SHELTON, 25 Peachtree St, Atlanta, Ga The invention relates to a device for the dispensing of drinking straws at soda fountains The purpose is to provide such a device which automatically delivers the straws singly to a convenient position for withdrawal, the remaining strays being housed and protected against dust or other foreign matter accumulating thereon.

EGG CARRIER —R MCN and H R WILLIS, 907 W Main St, Chanute, Kans The object of this invention is to provide a carrier of the character specified formed of pasteboard or like suitable material wherein the blank for the complete carrier may be stamped from a sheet of pasteboard or the like, and creased on lines which will permit it to be folded into a closed carton, having individual egg cells

PROCESS FOR THE AUTOMATIC REMOVAL OF COPPER FROM ORDNANCE —A E A DAGORY, Bois Colombes, Seine, 8 Ave Robert Bain, France This invention relates to a process for automatically freeing guns of all calibers from the copper which is deposited during the firing in the interior of the bore The operation consists of removing the copper by applying to the shell a compound of tin with lead, said compound to be projected along the walls of the bore and brought into contact with the copper deposited on said walls

SLED —W SCHULTE, Haddam Conn An object of the invention is to provide a sled of the self propelling type which may be propelled and steered by the operator at the same time, with a hand operating propelling means and a foot operated steering means The device is simple and durable in the construction, combination and arrangement of its parts

LETTER AND PACKAGE TYING DEVICE —M R HUGGINS, Bethel, Ohio The invention has for its object to provide a construction wherein the parts are reduced to a minimum and wherein after the first operation of tying it will remain straight and in proper position for all other additional operations A further object is to provide a device which will securely hold the letters bunched and yet permit one or more to be withdrawn without completely untying

WINDOW CLEANER —L SONDERFOGER 413 E 153rd St, Bronx, N Y The object of the invention is to provide a window cleaner more especially designed to permit the user to clean the outer faces of the upper and lower window sashes. Another object is to permit of readily placing the cleaner in position on the window and manipulating the cleaner without requiring undue physical exertion

SAFETY DESK.—M. H. LYTTLE, 374 W 80th Place, Chicago, Ill. The invention has for its object to provide a safety desk having a drop head which can be instantly dropped into a strong box which is automatically closed and locked, thus safeguarding articles resting upon the drop head from loss by theft, fire, or other causes A further object is to provide a device that can be operated by a person seated at or standing by the desk, without his action being observed

MOVING PICTURE CAMERA —S M. LAWRUN, address J L. Perlman, 1893 Vyse Ave, Bronx, N Y The object of the invention is to provide a moving picture camera arranged to permit adjustment of the shutter opening to produce dissolving or double exposure, or trick work effects and for taking pictures under different conditions of light intensity of different rates of motion of the objects, the shutter being composed of adjustable sections to vary the exposure opening

POLISHING COMPOSITION —J F LINANE, 343 Micheltorena St, Santa Barbara Cal The invention has reference more particularly to a composition especially adapted for the cleaning and polishing of hard wood and metallic surfaces. The object is to provide a composition which will be cheap to manufacture and yet will give a brilliant luster. The composition consists of the following ingredients mineral oil, oil of soy bean, turpentine, gasoline and tripoli

ONE PIECE SLIPPER —M J HOLLEBECK, 20 Orchard St, Gloversville, N Y Among the objects of the invention is to provide a one-piece slipper cut from suitable material, which may be designed over the human foot, the same as a surgical shoe, forming a perfect fit for the instep and at the side of the arch, leaving no seam at the heel which would cause irritation or discomfort

SHAVING BRUSH —L TOBIAS, 717 Jackson Ave, Bronx N Y The invention relates to a shaving brush equipped with the ordinary bristles for forming and distributing lather and also provided with means for rubbing the lather into the face to soften the beard, the parts being so constructed and arranged as to permit either the bristles or the rubbing device to be exposed for use at the end of a suitable handle, the brush is slidably mounted and may be entirely enclosed within the handle

GLOVE —H I SEELY, 450 Penn Ave, Waverly N Y The invention relates to heavy gloves for workmen, particularly engineers and firemen The glove is made of leather or similar material, liable to withstand great strain. The invention provides a method of joining the palm and thumb blanks of the glove by a lace in such manner that it will withstand any reasonable amount of wear, and will be practically heat, fire, acid and waterproof

Machines and Mechanical Devices

MACHINE FOR MAKING HAT LININGS R BELL, 27 Bond St, New York, c/o N Y Hat Lining Co The invention relates to machinery for producing hat linings and has for an object to provide a construction associated with an ordinary sewing machine whereby a lining member may be quickly and accurately formed Another object is to provide an attachment which may be easily manipulated for cutting strips of cloth into certain lengths after passing through the sewing machine and then cutting draw strings of a different length

MOTOR TREADMILL.—R D. GEORGE 4341 Tracy Ave, Kansas City, Mo. The invention relates generally to power apparatus, and more particularly to apparatus for the convenient application of power from the rear wheels of automobiles motor trucks, and the like, for external or distant application, the object being to provide a comparatively simple apparatus which may be readily associated in operative relation to the motor vehicle

MECHANICAL MOVEMENT.—G. MULLER, 103 Schley St, Glendale, L I The object of the invention is to provide a rack and pinion feed mechanism more especially designed for converting reciprocating movement into intermittent rotary movements in an exceedingly simple manner Another object is to insure proper transmission of the power without danger of injury to the working parts, at the same time reducing wear and tear to a minimum.

THREAD TENSION GAGE.—J. H. MESSINGER and A E TETU, Central Registry, Militia Department, Ottawa, Ontario, Canada. This invention relates to devices for indicating the tension of sewing machine threads and has for an object to provide a construction which will operate while the sewing machine is standing still, in order to allow a proper adjustment of the upper and lower threads, so that the device may be varied until the threads have the same tension, the variation being shown automatically on the gage

MECHANICAL MOVEMENT —F CLARK, 15 Bedwell Ave, Jersey City, N J The invention relates more particularly to a mechanism especially adapted for the conversion of reciprocating motion into oscillating motion. The primary object is to provide a device operated by one of the elevators of a typesetting machine to indicate certain conditions in the work being set up by the machine, the device may be readily attached to machines of this type as commonly constructed

Pertaining to Vehicles

AUTOMOBILE SEAT —G TASMAN, c/o Tower St, Forest Hills, Boston, Mass An object of the invention is to provide a seat construction in which there is substantially no relative movement between the seat and the back thereof, there being provided a means for yieldingly supporting said seat, and another means to permit the yielding support to become effective, but to prevent the seat from tilting from its normal position

VEHICLE —A H PELTER, Box 286, Bristol, Tenn The invention has for its object to provide a toy vehicle of the three wheel type, having laterally spaced driving wheels at one end and the steering wheel at the other, and a body to which the wheels are connected, and having a seat which may be quickly adjusted to permit children of different ages and physical development to ride in the vehicle comfortably

FENDER FOR MOTOR VEHICLES AND THE LIKE.—F V GUERRA, 100 Luyano, Habana, Cuba The invention refers more particularly to a fender which may be conveniently used on motor vehicles without presenting an unsightly or cumbersome structure on the front of the vehicle, the platform being so constructed that it will normally assume an inactive position in the rear of a collision buffer but capable of being automatically brought into use by the impact of person.

ENDLESS TRACK FOR FACILITATING THE PROGRESSION OF AUTOMOBILE VEHICLES ON HILLY GROUND.—E RIMAILHO, 12 Rue de la Rochefoucauld, Paris, France This invention relates to an endless track shoe for connection with self propelled vehicles, of the heavy type, to facilitate their travel upon uneven or hilly ground When the shoe is positively driven it also serves as propelling means for the vehicle

MEANS FOR EFFECTING TEMPORARY REPAIRS TO BROKEN AXLES OF MOTOR CARS —E J DOVE, 190 St John's St, Clarkenwell, London, E C 1, England This invention has for its object to provide temporary means whereby the driving axle of a Ford car, when broken at a point on either side of the differential gear, may be easily and quickly repaired either to permit the car to be towed on its own wheels, or driven away by its own power

RADIATOR CAP LOCK —T. HILL, 1135 Park Ave, New York, N Y The invention relates to closures for the filling opening of motor vehicle radiators. The primary object is to provide means whereby the surreptitious removal of ornamental caps is prevented. A further object is to construct a device of this character in such way as to adapt it to use on a radiator cap of any of the well-known types and to permit of its insertion through the radiator filling opening

SCOOP BOARD —W J COMBS, Box 24, Otterbein, Ind The object of the invention is to provide a scoop board especially adapted for use on wagons for hauling coal or granular material, wherein the board provides an end gate under normal conditions, but may be lowered into inclined or approximately horizontal position to serve as a scoop board, and wherein the pressure upon the board may be first relieved before the board is opened to permit its use as a scoop.

WHEEL.—L H KRICKEL, 300 S Grand St., Monroe, La The invention relates more particularly to a demountable rim. An object is to provide a device of this character in which the rim parts are so formed and associated with each other that while they are positively retained assembled and in position for immediate mounting on the wheel, they are adapted to be easily disassembled and reassembled to remove or replace the tire when necessary

AUTOMOBILE LOCK.—W. H. AUSTIN, c/o Morgan Austin Co, Greenville, S. C. This invention has for its object to provide mechanism of the character specified for locking the spare tire of a motor vehicle in a casing, adapted to be secured to the body of the vehicle, in such manner that it cannot be removed by an unauthorised person.

RADIATOR FILLER CAP.—C. F. TAYLOR, c/o Superior Bearing Bronze Co., 719 1st Ave., New York, N Y The invention relates to safety appliances for caps and has particular reference to filler caps for automobile radiators Among the objects is to provide a permanent connection between the cap and radiator structure to prevent possible loss of the cap, and to provide the connection for the quickest and easiest means for opening the neck for introducing water to the radiator.

DEMOUNTABLE RIM —W S. WATSON, 506 Sloan Bldg, Cleveland, Ohio An object of this invention is to provide a demountable rim without necessitating the use of wedges that are liable to distort the wheel and thereby cause excessive wear on the tire. A further object is to provide a rim having adjustable fastening means, so that the pressure may be equally distributed around the wheel. The device is especially adapted for use with inner rims of the flat band type.

TRACTOR FORWARD AND REVERSE GEARING —G H SCANLAN, c/o Consolidated Gas and Gasoline Engine Co, 202 Fulton St., New York, N Y Among the objects of the invention is to provide a tractor in which a simple effective reversing mechanism is provided which will be extremely small and simple in construction so as not to increase appreciably the size of the structure Another object is to provide a structure in which the wheels may be adjusted so as to raise and lower the casing to comply with different requirements

NON SLIP ATTACHMENT.—S C SHERRY, Park Ave, West Englewood, N. J. This invention relates to attachments for the drive wheels of trucks or other automobiles which will prevent slipping of the wheels in snow and mud, and hence prevent stalling of the car A further object is to provide a device which can me readily attached, and which will provide a laterally and radially projecting web to take hold of the snow
and mud, and hence prevent a device which can be readily attached, and which will provide a laterally and radially projecting web to take hold of the snow

GEAR LOCK —J O. TYLER, Box 376, Winchester, Ky An object of the invention is to provide means whereby drivers, especially beginners, may be better able to hold down the clutch when they go to shift the gears, and whereby the gears are locked in position and are not able to be moved by the gear shift rod until the clutch is depressed

VEHICLE BODY.—G P CONNEALY, Decatur, Neb The invention relates to vehicle bodies which can be quickly adjusted either to form a solid body for carrying grain or extended to form a large receptacle in the form of a slatted rack for shipping hogs, sheep or other animals. A further object is to provide a vehicle which in either form will be strong and durable in construction.

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Stopping the Chimney Thief

(Continued from page 115)

something that can be approached but not attained in practice. If carbon were burnt with twice as much air as necessary, only half of the 21 per cent of oxygen would be converted into CO_2 and the CO_2 measurement would be 10½ per cent. Three times as much air as necessary would mean that only one-third of the 21 per cent of oxygen was converted into CO_2, that is 7 per cent.

The percentage of Co_2 therefore shows how much air was used per pound of fuel. Modern power plants use very accurate instruments which continuously and automatically determine the percentage of CO_2 in the chimney gases. These instruments serve a double purpose. First they enable the fireman to maintain maximum combustion economy at all times and secondly they register a permanent autographic record in chart form which enables the manager of the plant or engineer in charge to ascertain whether fuel was wasted or conserved during any period of time. In all power plant work the modern tendency is toward permanent recording of all important operations. In no case is it more profitable to do this than in connection with CO_2 recorders which are making actual fuel savings of from 10 to over 30 per cent and more in the quantity of fuel burned.

When all power plant owners stop competing with the sun in trying to heat up the sky and the countryside and keep their heat within the limits of their own domains a very big forward step will have been made in eliminating our many fuel problems. A power plant never will be run efficiently until its operators learn to think in terms of ratio of air to fuel instead of in terms of fuel alone, or better still when they allow automatic instruments to do part of their thinking along these lines for them.

Open Roads All Winter

(Continued from page 104)

hedges which add to the highway's beauty are usually left and the drifts removed instead.

Where cuts drift full, or where the general contour of the country causes drifting, the erection of snow fences will prove helpful by clearing the air currents of snow before they pass over the road. These fences are erected on the windward side of the road 50 to 60 feet distant from the highway and may be either permanent or portable. On land which is used for agricultural purposes the portable fences have a wider adaptability in highway work, as they can be set up after the crops are harvested and removed before they are planted the next year. Snow fences may be either of the "board fence" or the picket variety. The best fence, however, is one made of light pickets held in place by strands of heavy wire. Such fences can be readily erected on driven posts and when not in use rolled up and stacked where they will be out of the way.

After all preventive measures have been employed much snow that lies as it falls and minor drifts which cannot be economically handled by the erection of fences must be removed. In some parts of the Northern States, even when preventable drifting has been eliminated, the snowfall is so heavy that the problem of keeping the highways clear is difficult.

Two methods of keeping roads open to traffic where the snow is heavy are in common use—compaction and removal. On roads where the traffic is light and is composed principally of horse-drawn vehicles and a few light automobiles, packing the road after each snowfall with a roller six or eight feet in diameter and from 10 to 12 feet long, will result in a passable road. The compaction method, however, is not satisfactory for roads where the traffic is heavy, or where many automobiles or heavy trucks must use the highway, as motor vehicles lose traction in snow and spin their drive wheels until they are stalled the same as in mud or heavy sand.

One great disadvantage of this system is that it facilitates the formation of ruts. Snow cuts away rapidly, and as there is a tendency for each vehicle to follow in the track of its predecessor, bad ruts are soon formed. These are often cut through to the underlying pavement which frequently is materially damaged thereby This tendency of snow to form ruts is one of the best reasons for removing the snow from highways Where snow ruts form, the damage done the highway is often much greater than the cost of removing the snow would have been

On roads which must be kept clear and where the traffic is such that compacting the snow is not sufficient, removal is the only solution This may be accomplished either by the use of plows or by shovels Rotary plows sometimes are used, but have not been commonly adopted for the work in this country. The present practice is to push the snow off the highway with blades similar to those used in road grading Indeed, road graders are frequently used for this work where the snowfall is light The more common method, however, is to fasten a heavy blade to a heavy truck and to use the powerful driving force of the truck to push the snow off the highway When the fall of snow is unusually heavy a second truck is attached to the one that carries the plow

As soon as two or three inches of snow has fallen, work is started. To prevent drifting, it is better to move all the snow to the leeward side of the road, but it may be shoved off to both sides The first clearings of the season should be made sufficiently wide to allow for storing the later snowfalls It is best to clear at least ten feet more than the traveled way This extra width, which is an inconvenience to make and adds to the cost of the removal of the first snowfalls, usually proves a time and money saver in the end

An efficiently operated truck can handle about ten miles of highway in snow removal work Preferably two assistants should accompany the driver, and the truck always should be in the best of condition If a heavy blanket of snow is being removed, a half dozen men with shovels should accompany the truck Under normal conditions, a well-handled truck should make one cut an hour If the truck is kept in constant operation as long as the storm continues the final result is an open road.

Occasions will arise, however, when high winds and the failure to provide proper snow fences will cause drifts to fill in, in spite of all the trucks can do When this occurs, the usual method is to put men in with shovels to clear away the drift. The width cleared by the shovelers should be sufficiently wide to give the trucks a chance to handle the later falls Hand work is expensive and the temptation to clear a minimum width is strong, but if the cuts are not wide enough for the trucks to handle later snow removals, the snow must be removed by hand and this increases the expense

In the past, Pennsylvania has been the leader in snow removal. This winter it is doing more than ever has been attempted in the State before Seventy-five additional trucks, with snow plows and correlated mechanical facilities and snow removal organizations, have been added to its equipment.

The snow removal problem in Pennsylvania is difficult because of its many mountains and heavy snowfall. By removal of weeds, brush, and obstructions along the roadside in the fall, and by the liberal use of snow fences, the highway commissioners of that State, however, have found it possible to control drifting in such manner that heavy trucks can

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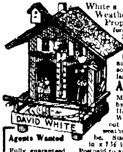

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keep the roads clear with a minimum of assistance in the way of hand work.

The Pennsylvania Highway Commission also makes use of the Weather Bureau of the United States Department of Agriculture in combating the snow. The Weather Bureau informs the Highway Department in advance of the approach of storms and this information is sent at once to the field engineers, who, with knowledge of the intensity of the coming storm and its probable duration, are more prepared to cope with it than they would be if it came unannounced. As getting on to the job in time and keeping on it until the storm is over are two of the most important factors in fighting a heavy snowfall, this advance information is of utmost importance in all States with a "snow removal program." Another admirable detail in the Pennsylvania winter program is the system of daily reports to the public on the condition of the principal highways. These are given both directly and through the Weather Bureau's daily bulletins.

No point on any of the designated routes in Pennsylvania is blocked more than twenty-four hours before the headquarters organization takes a hand and men and equipment from other points are thrown in until there are enough to cope with the situation.

Stunts of the Stage

(Continued from page 105)

of the stage under this shield and emerge from the water inside the wings.

For completeness of detail in scenic effects there probably is no better example than is offered in "The Gold Diggers." In one scene of this play two rooms, complete in every detail, are built behind the regular stage set which the audience sees. When an actor comes on the stage he enters one of these rooms, closes the door behind him and then enters the stage by a second door. Only at this time does the audience get the briefest glimpse into the room. Ordinarily a simple screen would be made to serve the purpose, but the producer of this play thought the elaborate setting necessary to secure the proper atmosphere. To heighten the effect (a ball is in progress) a twelve-piece orchestra is placed behind the scenes and it is heard only at intervals when the doors into the two extra rooms are opened.

For sheer cleverness of conception and execution the palm ought to be awarded to one of New York's motion picture palaces, which recently had its large orchestra directed from the screen by one of the animated characters of a famous comic cartoon. The "stunt" was devised by the snare drummer at the Rivoli Theater.

In the accompanying animated cartoon one of the characters leads an "animated" orchestra while the other sings. When the song is finished the roof has been blown off the theater, the audience has fled in wild panic and even the orchestra is gone. They determine to sing another song and for the purpose of accompaniment they borrow the theater's real orchestra. The cartoon character waves the leader to a seat when he takes up his baton and conducts the orchestra himself from the screen. The song is "The Curse of a Broken Heart," and the notes of the animated soloist are rendered in accompaniment by the drummer on an instrument especially designed for the purpose. It consists of an old bucket with the bottom knocked out. Over the end is stretched a skin and in the center is attached a resined rope. Weird sounds that follow the tune more or less closely are emitted when the rope is drawn through a resin-coated rag. An unearthly screeching-clattering sound produced by scraping an old piece of tin building cornice with another piece of tin interrupts the song. The comic characters engage in an argument with the drummer and the picture ends when the drummer jumps to the stage and apparently chases the two animated musicians from the screen.

On at least one former occasion an orchestra leader attempted to lead his orchestra from the screen, but this attempt was a failure. This time the leader was photographed in action and his image flashed on the screen. But it was found impossible to cut or edit the film because the elimination of a beat or a part of a beat threw the orchestra into confusion. It was found equally impossible to make a perfect film long enough to carry the orchestra through one piece. These difficulties were overcome by using an animated cartoon instead of a photograph.

Theatrical mechanics prove most useful, however, in the staging of a gigantic spectacle such as "Mecca," in which some 300 people take part. The whole production, in fact, must be a well-oiled mechanism. The performance is timed so that a certain piece of action takes place at a certain time and each player must be in a designated spot.

One scene in "Mecca" is shifted with the whole stage dark. The spot where each member of the company must stand during the shift is marked on the stage floor and should he or she move a foot to one side of this spot there would be danger of being run down by a piece of scenery.

A very large stage is required, of course, and in one scene a smaller stage, about the size of an ordinary theater stage, but mounted on wheels, is set in the wings and when the curtain goes down it is quickly pushed to the center and the story goes on with an interruption of only a few seconds for a complete change of scenery.

A new kind of stage fire is introduced in "Mecca," producing a most realistic effect. For several years theatrical producers who have made use of stage fire have paid royalties to a dancer who patented the familiar combination of paper streamers blown upright by an electric fan with colored lights playing on them.

In "Mecca" the fire appears in two huge brasiers at opposite sides of the stage. The "flames" are of burnished copper and they are gradually brought into view by a mechanism actuated by a small electric motor. Smoke from incense and flashing colored lights make a most realistic reproduction of fire.

The producer has used lights as an artist uses his colors and the result is an artistic masterpiece, vivid and colorful and ever-changing.

The World War on Rats

(Continued from page 105)

Other gases have been used, such as some of the poison gases developed for the war, but as a general rule these have been found too dangerous to warrant their use.

In open spaces the rat warfare must perforce be more difficult and less efficacious. First of all, the rats must be deprived of their food as far as possible. Fine meshed screens must be placed about food supplies to keep out rats. All these measures are only temporary, for rats can cut their way through wire netting of appreciable thickness and even through cement, if given sufficient time—and proper inducement.

Refuse, garbage, old rags, old papers—all these things must be abolished if rat warfare is to be a success. The plugging of rat holes does not appear to be of much avail, because the rats make new holes about as rapidly as the old ones are rendered useless to them. Cats are of little use because they hesitate to attack rats. Dogs, while more courageous, are perhaps more spectacular than effective in the rat war. Far more efficacious are certain birds of prey, which fall upon young rats in their nests.

The best methods are either to capture the rats by means of traps, or to poison them. The traps have to be baited with care, for we are told that the rodents have

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a remarkable sense of smell, and keep away from certain odors, such as tobacco and dead rats.

In various cities of the world a lively warfare against rats is under way. In Paris, 25 centimes per rat captured either dead or alive is being offered. In London a vigorous campaign is under way. New York has taken certain measures, and more thorough steps are being contemplated. New Orleans has constructed her warehouses to shut out rats, and the same can be said for San Francisco Many other cities are now engaged in waging what appears to be a successful fight against one of the worst pests that confront the well-being of the human race.

The Big Dam on the Little San Diego

(*Continued from page 108*)

tubing carries the water from this equalizing reservoir to the coast lands. This tubing varies from 20 to 26 inches in diameter

One of the views shows the downstream face of Hodges Dam. On the right is to be seen the system of buttresses In the center of the picture, this system ends and is succeeded by the concrete portion of the spillway Back of the whole structure is to be seen the valley of the San Dieguito River, now occupied in part by Lake Hodges Another view shows a siphon resting on its trestlework Still another view shows the upstream face of the great dam The flutes of the main dam and also of the concrete spillway (on the right) are plainly to be seen here

Hodges Dam and San Dieguito Dam are two of four distinct dams that have been built to one general type of design in a single California county, San Diego County The former of these is perhaps the tallest multiple-arch dam in existence One of the others is Murray Dam It was built to increase the storage at that time provided by the old La Mesa Dam. In January, 1916, this old structure, a hydraulic-filled dam 65 feet high, was nearly carried away by the great flood then rampant The Lower Otay Dam had failed with severe loss of life and property and the south dyke of the Sweetwater Dam had also gone out The water had risen to within just about one foot of the crest of the old La Mesa Dam Overtopping the crest meant the failure of the dam and great damage to property and loss of life However, there was a sluice gate at the base of the dam which was closed It was finally opened and the dam thereby saved The new dam which supplements the old structure is Murray Dam It has 30 arches of a span of 30 feet each The height is 117 feet and the length 900 feet Just as is the case with Hodges Dam the slope along the crown of the arches is 45 degrees Both dams have their inclined flutes surmounted by short vertical ones Murray Dam has in one bay at the extreme north end a self-charging siphon spillway. Its capacity is double the flood inflow of the great flood already mentioned. It is claimed that this device will regulate the level of the reservoir within 3 inches of the summit of the main coping. The spillway level is the same as that of the cope and the result of the automatic arrangements is a regulation of 100 per cent efficiency.

A multiple-arch dam may often be built very rapidly Murray Dam was built in 7 months; San Dieguito Dam in less than 4 months They are sometimes quite economical. Thus, the designer claims that the Murray Dam cost less than any other dam of its size in the world.

The remaining multiple-arch dam of San Diego County is Eagles Nest Dam This is a little fellow built to create a fish pond and to impound water for a small lighting plant. The designer, Mr Eastwood, calls the type exemplified here a Matilija or Butterfly Dam. The plan presents a butterfly appearance. There

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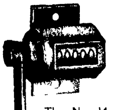

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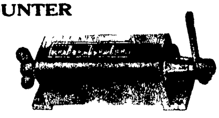

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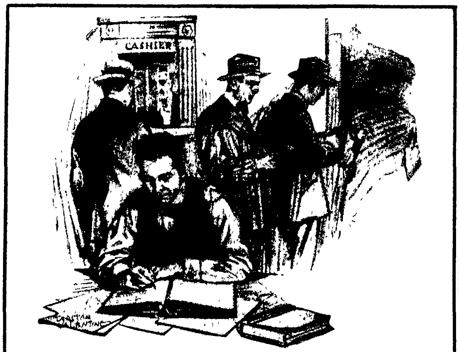

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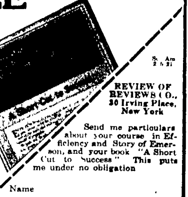
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are three arches. It is the first of its kind ever constructed. The central arch has a span of 70 feet and the side ones a span of 25 feet each This dam closes an opening of 125 feet wide There are only 184 cubic yards of concrete in the structure

Scientific American Monthly for February

(Continued from page 109)

tecture illustrating his story with photographs taken by himself

What is the place of life in nature? How is this peculiar and special development which we describe as living to be derived from a cosmos which close observation shows to be subject everywhere to rigid determination by mechanical and mathematical laws? The question is asked by Dr Ralph S. Little, who proceeds to discuss the problem in an able article

Owing to the phenomenal demands for furs in recent years there has been a greater temptation than ever to substitute inferior furs for the more valuable ones by clipping, dyeing or pulling them, thus the appearance of the furs are so altered that it is difficult for anyone but an expert to distinguish the genuine from the imitations An article by Dr Leon Augustus Hausman deals with this subject and shows how the microscope enables us to distinguish the various furs

"Indian Uses of Kelp" is the title of an interesting article by J. C Leachman, in which he tells of various articles made by North American Indians out of different kinds of sea weed These include fishing lines, bottles, and even toys, sections of stem being used to make the wheels of toy wagons Sea weeds were also used in ceremonials and as amulets Unfortunately owing to the perishable nature of the materials, many examples of the use of kelp have been lost, but enough have been preserved to illustrate the value of marine vegetation to these primitive peoples

With the all-seeing eye of the Roentgen ray experts are now examining old paintings to determine whether they are genuine It has been found that the pigments used in previous centuries are much more opaque to X rays than are modern paints made of aniline and vegetable dyes The antiquity of paintings can therefore be determined by noting their opacity to the X-rays The process is described in the February Monthly and is illustrated with some very interesting photographs and radiographs

The February issue contains the usual departments of notes on various branches of technology and scientific research with the exception of the department conducted by the National Research Council, which is omitted this month, but will appear in the March issue

The Heavens in February, 1921

(Continued from page 112)

Capella is high in the northwest, with Perseus below, and Andromeda setting Cassiopeia, Cepheus and Draco are low on the northern horizon. The Little Bear is above the last two, and the Great Bear much higher, in the northeast

Arcturus has just risen, north of east, and Spica is rising farther to the southward Leo is well up in the east, and Hydra stretches from the southeastern horizon almost up to Procyon. A number of the bright stars belonging to the constellation Argo may be seen low on the southern horizon, but they are not conspicuous, as they are in southern latitudes and the brilliant region of the Milky Way (which surrounds them is hardly visible to us at all

The Planets

Mercury is an evening star throughout February He reaches his greatest elongation or apparent distance east of the sun upon the 15th At this time he is almost exactly in perihelion and his apparent distance from the sun is therefore unusually small, 18° 8'; but to compensate for this he is more than 7° farther north than the sun, and is therefore easily visible, setting at 7 P. M. He is brighter than any of the stars except Sirius, and should be conspicuous in the twilight. By the end of the month he gets very near the sun, and is lost to sight.

Venus is likewise an evening star, and she also reaches her greatest elongation during the month—on the 10th—at a distance of 46° 46' Being farther north than Mercury, as well as farther from the sun, she remains visible until 9:20 P. M. Telescopically she looks exactly like a half-moon, though of only one-eightieth the apparent size.

Mars, too, is in the evening sky, between Mercury and Venus, but only half as far from the latter as from the former, and remains in sight until after 8 P. M. He is about 200 million miles from the earth, and is correspondingly faint.

Jupiter is in the eastern part of Leo, and rises a little after 7 P. M in the middle of the month, so that he is well placed for observation before midnight. Saturn is on the western edge of Virgo and about seven degrees east of Jupiter, rising approximately half an hour later. He is a telescopic object of extreme interest, for his rings are turned almost edgewise toward the earth. During most of the month their plane passes between the earth and the sun, and only the dark side is visible, so that with all but the greatest telescopes the planet appears merely as a disk, while with very powerful instruments the rings may be faintly seen illuminated by the light reflected from the planet, together with that which filters through from the sunlit side between the fine particles of which the rings are composed On the 22nd the rings are turned exactly edgewise toward the earth, and (as previous observations at this phase have shown) they will be wholly invisible in even the greatest instruments Then for about seven weeks we will see the sun lit side of the rings, very nearly edgewise, as a thin spike of light projecting from each side of the planet

Uranus is in Aquarius, still an evening star, but too low to be observed On the 24th he passes behind the sun and becomes a morning star. Neptune is in Cancer and comes to opposition on the 1st At that time he is in 8h 5m 26s R A and 17° 8' north declination He moves slowly westward, and on the 27th is in 8h 56m 39s, 17° 20' north Observers with equatorially mounted telescopes may find him along the line thus indicated, but a fairly large aperture will be required to show the planet's disk

The moon is new at 5 87 P. M on the 7th, in her first quarter at 1:53 P. M. on the 15th, and full at 11 32 A. M. on the 22nd As this calendar month is shorter than the lunation, the moon does not pass through her last quarter in February at all She is nearest the earth on the 20th, and remotest on the 5th. While making the circuit of the sky she passes close to Uranus and Mercury on the 9th, Mars early on the morning of the 11th and Venus on the same evening, Neptune on the 20th, and Jupiter and Saturn on the 23rd The conjunction with Venus is close, and an occultation is visible in Asia; but we are unfortunately on the wrong side of the earth and will see nothing of this

Skjellerup's Comet

An orbit of this comet has been computed at the University of California from observations covering an interval of nearly three weeks, and should be very near the truth. According to this the comet passed perihelion on December 11, at a distance of one hundred and thirty million miles from the sun Its orbit is inclined 22° to the ecliptic, and it passed through the ascending node about two weeks after the perihelion. It is now slowly receding from the sun and more rapidly from the earth and growing steadily fainter, and there is no chance that it will ever become conspicuous.

IN THIS ISSUE: LEADING NAVIES COMPARED
HOW WE THINK

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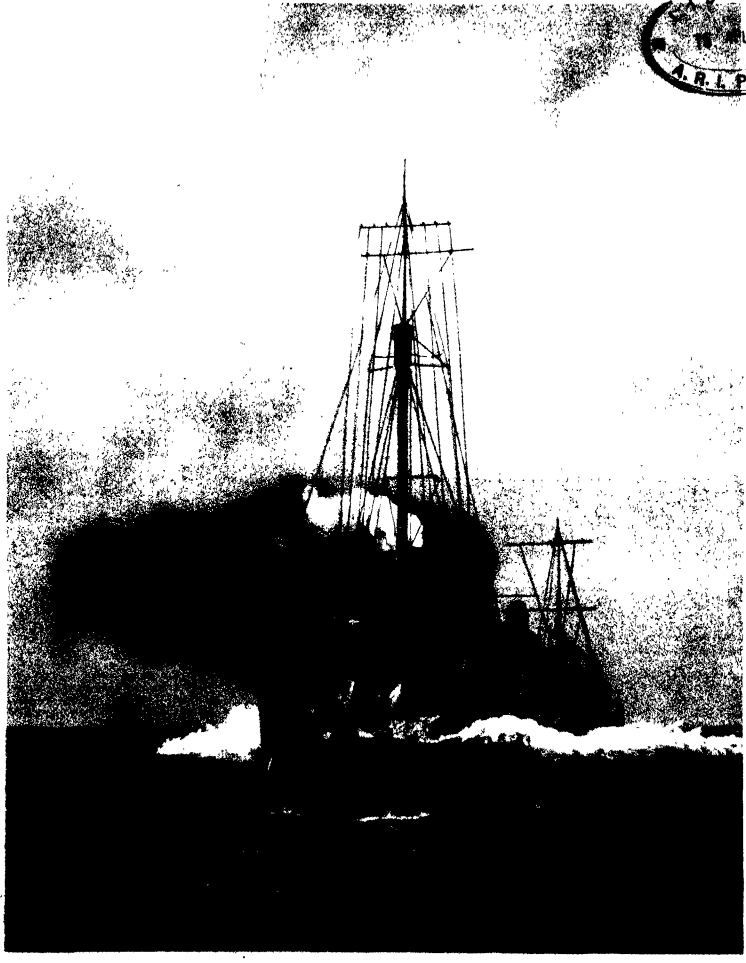

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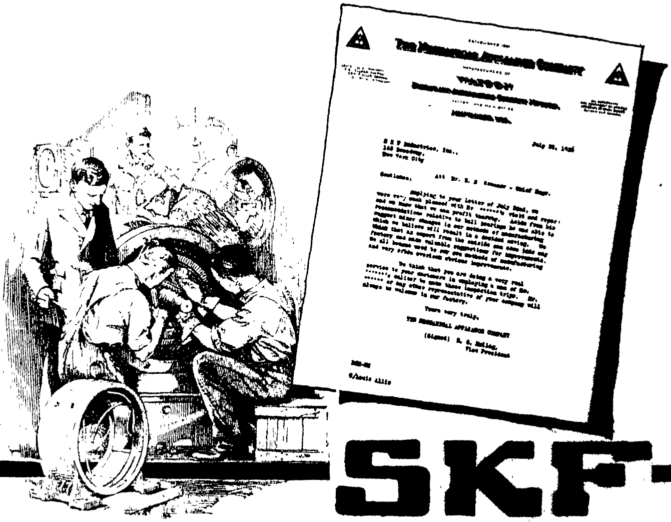

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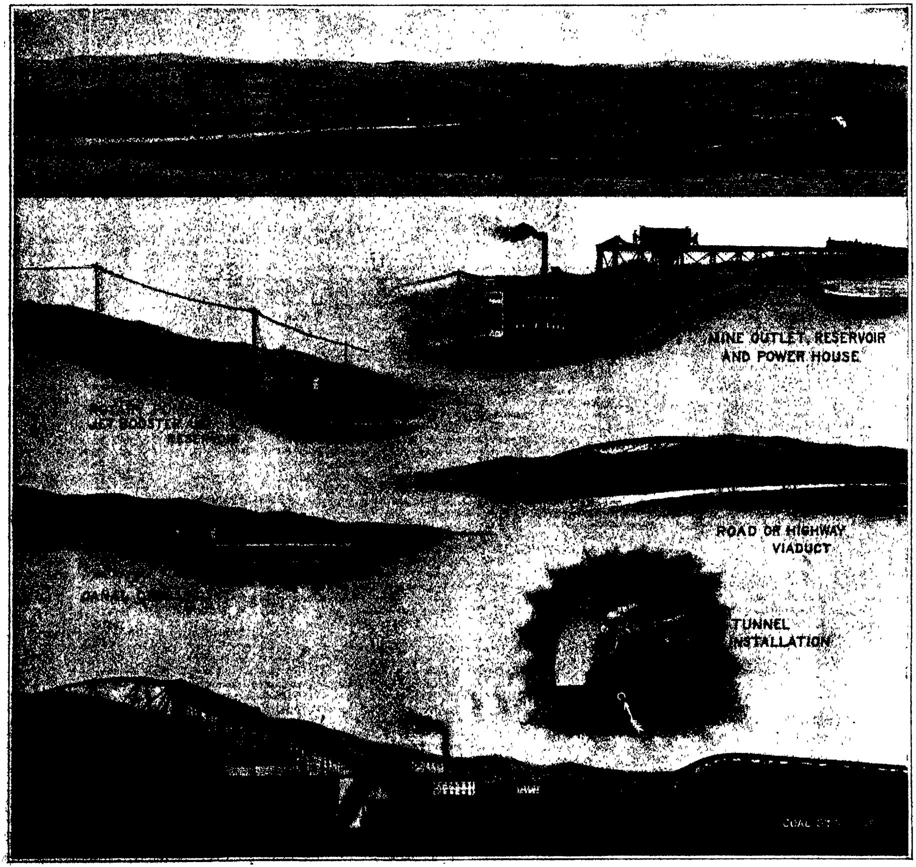

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Some of the leading features of the proposed scheme for transporting coal through pipes under water pressure (See page 126)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A Second Panama Canal

SECRETARY OF WAR BAKER is reported to have stated that he would favor the construction of a second Isthmian canal, either paralleling the Panama Canal or cutting through Nicaragua. No doubt the day will come when the proposition of enlarged accommodations will have to be faced, though it cannot be said that the present canal has by any means reached the limit of its capacity. Nevertheless, prudence suggests that we should look ahead and be prepared for this contingency. There are only three possible methods by which enlarged ocean traffic across the Isthmus can be accomplished, namely, by a new canal through Nicaragua, by a new canal near Darien, or by widening the present canal. A canal at Nicaragua would involve large and difficult dam construction and enormous retaining walls along the sides of the valleys through which the prism would have to be built. To say nothing of the risk of earthquake shocks, its cost would be prohibitive. A canal at Darien would involve the construction of a tunnel 150 feet wide, and at least as high, through the mountain divide. The risk of displacement of the roof through earthquake shock would be so great, even if it were heavily concreted, as to prohibit the use of this route.

There remains the alternative of enlarging and, if possible, doubling the existing canal. This could be done by building two sets of locks adjoining the present locks, provided suitable rock foundation could be found at the various sites or some method of massive concrete pile supports were found to be practicable. For the first few years the existing prism might prove to be of ample capacity, but ultimately it would be necessary to widen the canal throughout. In the Gatun Lake this would be a matter of simple dredging, but it would involve an enormous amount of rock work through the Culebra Cut, which would be followed inevitably by the old trouble of heavy slides, until the material found its natural angle of repose. The task would not be beyond the resources of modern engineering, but in view of increased labor and material costs the enlargement would call for capital approaching that which was necessary for the construction of the existing canal. The determining question, however, in the enlargement of the canal would be the summit water supply, and it is doubtful whether the flow of the Chagres River would suffice for more than the addition of one single lock adjacent to the existing locks.

The King's Cup Ocean Race

NOT for many years past has anything been done to promote deep-sea yachting that will compare with the offer by King Albert of Belgium of a gold cup for an ocean race from Sandy Hook to Ostend. The fleet of yachts which will start from the Ambrose Lightship on the morning of July 4th next will cross the finish line at Ostend in the height of the season at that now historic watering place—historic because here was fought one of the most heroic naval contests of the war. Ostend, which for over four years bristled with seacoast guns and resounded with the crash of heavy artillery, will be her old self next July, when the white-winged racing yachts sail into harbor, through channels which so long were shut in by the deadly mine field and by warships, sinister in their dark gray paint. They will be welcomed by pleasure-loving throngs upon those very piers and esplanades which so lately were disfigured by the gray-coated soldiers of an invading army.

It was fifteen years ago that another fleet of ocean-going yachts sailed a transatlantic race for the once-famous Kaiser's gold cup, which, by the way, on being sold for war or charitable purposes, turned out to be of gold-plated pewter. We may be sure that there will be no pewter in King Albert's Cup. It will be pure gold, like the gallant King himself, than whom no outstanding personage of the war has come through with greater honor, respect and love of the peoples of the world. The Kaiser's Cup was won by William Gardner's design, the famous three-masted schooner, "Atlantic." She still sails the sea, but under a greatly reduced rig, her lower masts having been cut down some ten feet, we understand, from their former length—a huge reduction. Other big and fast yachts have been launched since that date and will be entered, no doubt, in the contest. There is the Herreshoff-designed "Elfay," a two-masted schooner whose rig also has been greatly reduced for cruising purposes, and there is the "Undaunted," a three-masted schooner designed by Wells, whose huge sailspread has not, we believe, suffered the clipping to which her probable competitors have been subjected. Whether the owners of some of these and many other big craft will feel disposed to go to the expense of resparring and recanvasing their yachts or no has yet to be determined. We rather expect to see it done, for as the entries multiply and the time for the great event draws near, the sporting spirit will be strong upon the owners of these big craft to give them every advantage that racing canvas and trained racing crews can bring.

The race is to be sailed without time allowance, and the start will be made independently of wind and weather, which means that it is to be a thorough sea-going test. Other things being equal, the race should be to the strong—that is to say, in this case, to the big ship, for length means speed. On the other hand, July is apt to provide a considerable portion of light airs and head winds, in which case some of the smaller schooners and single-stick craft of purely racing model may push their bigger sisters to a close finish. That staunch racing cutter, the 23-meter "Shamrock," is in winter quarters on this side of the water, and it would add to the interest of the race if she should be among the yachts at the starting line. Since she was built under the international rule, the yacht is staunch enough to face a transatlantic race in the summer season.

Disarmament of the British Navy

ALTHOUGH we are most heartily in favor of a universal reduction of naval and military armaments, we deplore the fact that there has been, and is today, much confused and misleading speech and writing upon this momentous subject. Some of this confusion of thought is unintentional and due to lack of knowledge—but too much of it is intentionally misleading and deliberate. If we are to get anywhere in this discussion, we must start with clearly ascertained facts and proceed by sincere and logical reasoning.

That very small minority in our Navy Department which would like to see the United States spend about one billion dollars in building "incomparably the most powerful fleet in the world" has endeavored to give the impression that a great naval shipbuilding competition is in progress between the other leading navies and ourselves. Now, as regards the British navy, this is absolutely untrue. If there be any naval race, we have the course entirely to ourselves, for Great Britain is doing no new shipbuilding whatsoever, and relatively to our own fleet, that of Great Britain is not so powerful as it was before the war. To be clear upon this point, let us consider the past seven years, and the losses of the British by war and by the breaking up and sale of ships since the armistice.

During the war Great Britain lost out of her fighting fleet over 600,000 tons or two-thirds as much tonnage as there was in the United States fleet in 1914. The facts regarding this tremendous depletion of her navy are to be found in a pamphlet published by our Office of Naval Intelligence, entitled "Information Concerning the United States Navy and Other Navies." From this we learn that her losses by mine, submarine, shell fire and other causes were as follows: three battle-cruisers, including the super-battle-cruiser "Queen Mary" (63,000 tons), 13 battleships, including the 23,000-ton dreadnaught "Audacious," and the 19,250-ton dreadnaught, "Vanguard" (201,000 tons); 10 armored cruisers (151,000 tons), 9 light cruisers (51,500 tons); 6 monitors (8,125 tons), 67 destroyers (50,500 tons); 52 submarines (37,000 tons); and 22 sloops (20,000 tons). The total, including other smaller craft, is over 600,000 tons. Added to these was a loss of 87 merchant auxiliaries, including many ships of from 12,000 to 18,000 tons, which brings the total loss to nearly three quarters of a million tons.

To make good these losses and to keep pace with the demands of the war, she took in hand a large program of new construction. But when victory was assured and the world-menace of the German fleet had been removed, all outstanding contracts were canceled, except in the case of certain vessels of the smaller types that were near completion, and a large number of ships, including three sister ships to the 42,000-ton battle-cruiser "Hood," were broken up on the stocks and sold as junk. These facts cannot be too strongly stressed, in view of the impression which has been conveyed by Senator Reed, Senator Phelan and other well-known politicians of their school, that Great Britain is still surging ahead with a vast program of naval expansion. As a matter of fact, it is some seven and a half years since the British Admiralty laid down a battleship, and of light craft not one has been ordered since the fall of 1918.

Furthermore, in agreement with her conviction that the war was indeed over and a period of peace and reduction of armaments was at hand, Great Britain struck off from her active list practically the whole of her big fleet of pre-war dreadnaught battleships, her armored cruisers, her protected cruisers and a large number of destroyers, submarines and other smaller craft, the list totaling about 150 ships that were either retired, sold or broken up. Not only this but she has tentatively condemned all of her capital ships that are armed with guns of 12-inch caliber or less; and although she has still on the list 26 dreadnaught battleships, several of these that are armed with a 12-inch gun are in reserve, or have been delegated to minor duties as practice ships, gun training ships, and so forth.

Another point which is perhaps the most significant of all, and one which will be fully appreciated by all naval men, is that in her whole fleet there is only one ship, the "Hood," which embodies in its construction and arrangements the enormous amount of technical information gleaned from the Battle of Jutland, information which was loyally passed on to the experts of her ally, the United States. Had she gone ahead with her program as we have done, she would today have in her fleet three additional ships of the "Hood" class, her fleet of light cruisers would have been greatly increased, and she would have added over 100 ships to her fleet of destroyers and submarines, all of these vessels embodying the lessons of the war and particularly those of the Jutland engagement.

We think we have made it clear that in this matter of disarmament, Great Britain has already taken the lead, since she has not only greatly reduced her existing navy, but for two years past has refrained from laying down any new warships. Here was a lead in naval disarmament which we might very well have followed, and those of us who are keeping our heads clear of international suspicions and hatreds, and are looking at facts as they are, must feel that there is no little truth in the following statement of the British Naval and Military Record: "Had the United States followed our lead in effecting such sweeping reductions in naval material, the world would not now be faced with the prospect of a new era of naval rivalry. It is practically certain that but for the American decision to complete not merely all the vessels authorized by the 1916 program, but nearly all the destroyers, submarines, et cetera, ordered under the emergency war programs, Japan would not have introduced her 1920-1928 Navy Bill, thus giving a new and powerful impetus to international competition."

Electricity

Portable Phase-Sequence Indicator.—To enable phase sequence to be determined easily an American manufacturer is placing on the market a light and compact indicating device. It is so designed that when the phases of a circuit are connected to the binding posts a pilot lamp set into a recess in the case indicates by its brightness or dimness the direction of phase rotation. A push button in the case reverses two of the leads and provides the contrasting indications of the lamp by modifying the magnetic flux resultant of the interior coil windings. The device has no moving parts and weighs less than three pounds.

Electric vs. Fuel-Fired Furnaces.—The pronounced advantages of the electric furnace in providing easy and positive temperature control and uniform heat distribution are held to account for a large number of these furnaces that have been placed in service during the last few years, according to *General Electric Review*. It is said that nearly all the brass-melting furnaces now being installed are electric furnaces. While in many cases the electric furnace has been selected on the basis of performance rather than on cost of operation, the rising cost of fuel and even the cost of operation may be decidedly in its favor.

Remote-Control Panel for Radio Stations.—An American builder of radio equipment has scored a distinct forward step in a highly convenient form of remote-control panel which is destined to save much time and labor in the operation of radio sets of substantial size. The panel, which can be mounted on a desk or table so that its two keys are flush with the top of the desk or table, is intended to govern the important circuit adjustments at a distance from the main apparatus assembly. This equipment is being marketed for 2 kilowatt sets, is being built for 5 kilowatt sets, and may be built soon for units up to 30 kilowatt rating.

The Variation of Thermal Conductivity during the fusion of metals is discussed in a recent issue of the *Philosophical Magazine*. The results of a long investigation are summarised as follows: (1) The thermal conductivity of tin, lead, zinc, and aluminum decrease with the rise of temperature up to their melting point. (2) For these metals thermal conductivity decreases abruptly during melting. (3) The thermal conductivity of bismuth and antimony slightly decreases at first and then increases a little. (4) During melting the conductivity of bismuth considerably increases, and that of antimony seems to increase only slightly. (5) The thermal conductivity of all liquid metals here investigated decreases but slightly with the rise of temperature. (6) The above changes of thermal conductivity are similar to those of electric conductivity for the same metals.

Canada—Second in Developed Water Power.—According to a recent study of water power resources of different countries, Canada has the greatest per capita water power development of any country in the world excepting Norway. This development is 0.26 horsepower per capita, while that of Norway is 0.54 horsepower, and of the United States is 0.07 horsepower, according to *Electrical Review*. The United States, with 30,000,000 horsepower available, leads the world in potential and developed water power resources, Canada ranking second. In general, Canadian water powers are applied to three uses; (a) Municipal purposes; (b) for manufacture of pulp and paper, and (c) for electrochemical and similar processes. Of the developed water power about 78 per cent is used for municipal purposes, about 14 per cent for the pulp and paper business, and about 8 per cent for electrochemical or similar processes.

The Largest Submarine Cable in the world, so it is believed, was recently opened for traffic when direct telephone communication was established between East Prussia and Germany over a 160-kilometer (100-mile) cable in the Baltic. This telephone connection, according to *Electrical World*, must go over a roundabout route in order to comply with certain regulations in the Versailles peace treaty concerning the "open road" from Poland to the Baltic. The cable contains six pairs of "krarupized" telephone conductors and three single conductors for telegraphic purposes. The cable has a paper-strip insulation close to the wires and then a lead cover reinforced by a double helix of steel wire with a ¾-inch pitch. The outside covering is made of jute and compound and is protected by a 0.2-inch armor made up of twenty-nine galvanized wires of steel with S-section. The outside diameter of the cable is 2 inches, and the weight is about 11 tons per kilometer (18 tons per mile).

Science

Captain Robert A. Bartlett, who made several Arctic expeditions with Admiral Peary, is trying to raise money to finance an expedition across the North Pole in an airplane. If the sum of $300,000 is raised the expedition will probably take place.

Meeting of German Scientists.—The German equivalent of the British and American Associations for the Advancement of Science—the Gesellschaft deutscher Naturforscher und Aerzte—recently held its first meeting in seven years, at Bad Neuheim, with an attendance of 2,600 members.

Abraham's Wells, Beersheba, Palestine are now equipped with modern pumping machinery and are supplying water to the town. From time immemorial wells at Beersheba have supplied the Bedouins with water for their flocks. The original "Well of the Oath" as dug by Abraham is described in the book of Genesis.

Prohibition Benefits Natural History!—A new weapon has been placed in the hands of the 'drys.' Before the adoption of national prohibition one of the only two skulls of the mammoth, *Elephas primigenius*, adorned a Cincinnati barroom, the proprietor of which refused all offers for it. Now that his business has been legislated out of existence, the skull has been acquired at a modest price by the U. S. National Museum.

The "Rain of Blood," a curious phenomenon of south France and Italy, occurred recently at Monte Carlo and Mentone. After the downpour ceased the roofs, roads, gardens and shrubs of the Riviera were covered with sticky crimson. The superstitious inhabitants of the gambling metropolis were much terrified. There is, however, a scientific explanation which is perfectly satisfactory. It is that the rain clouds had been saturated with red sand from the Sahara Desert.

Mating Habits of Wrens.—Prentiss Baldwin of Cleveland told the Wilson Ornithological Club the results of his investigations of the migrations of birds at his Cleveland home and also at his winter place in Georgia. Contrary to general belief, the house wren frequently is divorced from his mate during the season, said Mr. Baldwin. Some wrens return year after year with the same mates, while others have been discovered with two different mates in the same season.

X-Rays in Material Testing.—X-Rays are now being used to show up defective materials, workmanship and weak metal castings in airplanes. Grains of wood in airplane parts are brought out remarkably and it is easily discernible where two different woods have been joined together, a point of construction prohibited in airplane work. Knots in the wood are also shown up, and also unsatisfactory gluing together of parts. Electric heater coils are inspected by X-ray and the plates show the manufacturer where air has caused the insulation of the coil to disintegrate, and where the wire will eventually break.

Permanent Sprinkling.—It is possible many of our readers have wondered at the appearance of the tracks at the subway stations in New York City. There is usually a realistic Christmas snow on the tracks, but the Interborough Co. has a method in this artificial snow system. The road-bed around each station is spread with calcium chloride which has a peculiar property of drawing moisture out of the air and turning gradually from a white powder into drops of liquid which remain in this condition for months. This serves to hold the dust and bacteria like the sprinkling of a dusty street. The hurtling of trains through the stations have little or no effect on this deposit.

Alaskan Volcanic Fires.—At the recent meeting of the American Society for the Advancement of Science, Dr. Robert F. Griggs described a fiery flood which occurred in Alaska, in the "Valley of Ten Thousand Smokes." Here he found traces of the flood of fire which, issuing from a fissure in the earth swept a roaring torrent of molten sand through the fertile valley, devastating all in its path for a distance of more than fifteen miles. From thousands of fissures live steam, heated gas and smoke issued. One could do one's cooking in any of the smaller holes. And that was the only salvation of the expedition, for all fuel had been destroyed by the flood of fire. It is only a few steps from the steaming fissures to a cave in the side of a glacier in order to have the most perfect refrigeration in the world. The explorers' tents were steam-heated, as it were, and the bathing conditions were of the best for a stream from the glacier fed a crystal pure lake and in the middle of the lake a steam jet bubbled and it was possible to get any desired temperature.

Aeronautics

New Deutsch Challenge Cup.—It is understood that Madame Henry Deutsch de la Meurthe has intimated to M. Michelin, president of the Aero Club of France, that the Deutsch family will present another international challenge cup for the greatest speed achieved in an airplane, together with a prize of 200,000 francs.

France-Morocco Air Mail Service.—According to information which comes to us from *Aeronautics* the air mail service between Toulouse, France and Casablanca, Morocco, which has been in operation for some time past for the outward transmission of letters to Morocco is now being carried on three times instead of twice a week in each direction.

Airplanes and Forest Fires.—According to *Aerial News Weekly* airplanes of the Army Air Service operating in California and Oregon doing patrol duty located 494 forest fires in less than two and one-half months. Fifty-three of these fires were reported by wireless from airplanes assigned by the Air Service to cooperate with the Forestry Service in protecting national forests from fire.

Bombing a Battleship.—Although they succeeded in making a rather sorry mess of the obsolete battleship 'Indiana' which the Navy has turned over for aerial experimental purposes, the five seaplanes of the "F S L" type did not succeed in sinking her. While the battleship was under way at a speed of 10 knots—she was controlled over an erratic course by wireless from the "Ohio" five miles away—the seaplanes attacked her and five of the 25 bombs hit the target squarely. Part of the deck was torn up, the smoke stacks suffered severely, and the deck was strewn with débris, but the old battleship still remained afloat.

German Views on Amphibians.—German aviation experts are expressing their views freely in regard to amphibian aircraft, writes the Handley-Page Berlin correspondent, and are skeptical as to the practicability of using the Thames in the center of London as the starting and landing place of these huge flying machines. They point out the dangers and difficulties which in their opinion must inevitably arise on rivers flowing through the center of such cities as London and Paris, where the shipping traffic is already sufficiently congested. Another objection raised by German aeronautical engineers is that the useful load and the earning power of the amphibian are less than that of the airplane.

That Caproni Giant.—For a long time back rumors have been coming to us of the remarkable giant machine being constructed by the Caproni Brothers of Italy. Now we learn that this machine, a huge flying boat with a capacity of 100 passengers, is completed. It has cost $800,000 to construct, and over four years of constant labor. The machine is remarkable for the absence of a tail. It is composed of three sets of three planes each, above a long fish shaped boat. The passengers are carried in the cabin which forms the boat body. The length of this machine is 75 feet and the width 108 feet. It is equipped with eight 12-cylinder motors. The total lifting capacity is twenty six tons.

Aviation in France.—Speaking at the Aero Club of France recently, M. Flandin, Under Secretary for Aeronautics, said that whereas in 1919 the aggregate distance flown in France was 218,750 miles, the distance flown in the first ten months of this year totaled 937,500 miles. Likewise the number of passengers carried grew from 960 in 1919 to 6,750 in the ten months of this year, while the amount of mails carried increased from 9 hundredweight in 1919 to well over 5 tons this year. The cost to the State in subsidies amounted to about $600,000. He went on to say that there were now 2,800 miles of routes in France in regular operation. The ratio of accidents was one to every 62,500 miles flown, and the fatal accidents worked out to one for every 134,374 miles.

Aircraft and Thunderstorms.—An experienced flier discusses the possibility of airplanes in flight being struck by lightning during a storm in a recent issue of *Illustrierte Flug-Welt*. His remarks are based on some seventy flights under such circumstances and on general principles. He shows that no danger is to be expected in the first place if the machine is not in the direct line of the discharge, and in the second place even if it is, it is not likely from the nature and distribution of the conducting metal portion that danger due to fire will arise. Out of thirty cases where the machine was struck directly, the writer maintains that there were no evil effects, while in all known cases in Germany where a machine fell during a storm there was no evidence of scorching of parts or melting of metal.

A Giant Job of Underpinning

Building a Subway Beneath Philadelphia's City Hall, with Its Inadequate Foundations

By William A. McGarry

PHILADELPHIA subway engineers have just completed what is conceded to be the largest underpinning operation in the history of the world Since the cost of building a 700-foot station in connection with this work has been almost $3,000,000—or between $21,000,000 and $22,000,000 a mile—it is probably also the most expensive piece of subway construction existing

Briefly, the tremendous weight of one hundred thousand tons, one quarter the total mass of the Philadelphia City Hall was shifted twice with an average settlement of but one quarter of an inch This great pile was transferred first from its original defective rubble foundations to new foundations of concrete and brick Subsequently the rebuilt foundations were incorporated in and supported by the subway roof, which, in turn was supported by concrete walls carried to rock by steel piles

The contract for this work was let in August 1915 It called for the construction of the central subway station in the city's proposed new system of underground railways, a four track affair with as many platforms, and with mezzanine and gallery floors to distribute traffic, all to cut under sections of the north, west and south walls of the City Hall and under the north and south branches of the Market Street Subway which circle the hall at present

Only the usual preliminary surveys had been made prior to the signing of the contract, and these in no instance revealed the character of the foundations of City Hall That building was constructed many years ago, before steel skeleton work came into general use It is a seven and eight story structure of solid brick and masonry, covering an area of four acres around a square courtyard, and it stands in the center of the intersection of Broad and Market Streets the two main central traffic arteries

Because of the method of construction it was known from the beginning that the task of running a subway under this building would be a delicate operation, as masonry structures are extraordinarily heavy and liable to crack or even to collapse when disturbed But the engineers, although they consulted what building records were available, failed to take into consideration the element of politics in the original work. They assumed that, since the building had stood for nearly half a century without showing any but minor cracks, its foundations must also be of solid masonry, the underpinning of which would be a difficult task for the reasons stated, but not at all outside the range of engineering experience Plans were made and the contract let on this assumption, and work was started late in 1915 at the northwest corner of City Hall.

Within a few days the excavation had been carried down to the foundations of the building And then the engineers discovered that these consisted in great part of rubble made of loose rock and gravel, with hardly any mortar It was found that the builders of the structure excavated trenches in some instances almost in the form of inverted pyramids. These were filled with the rubble. Then a masonry course was started, but it was so poorly constructed that in some places there was room between the slabs of stone for a man to insert his head and shoulders. Above this came a solid wall of brick work to the basement of City Hall.

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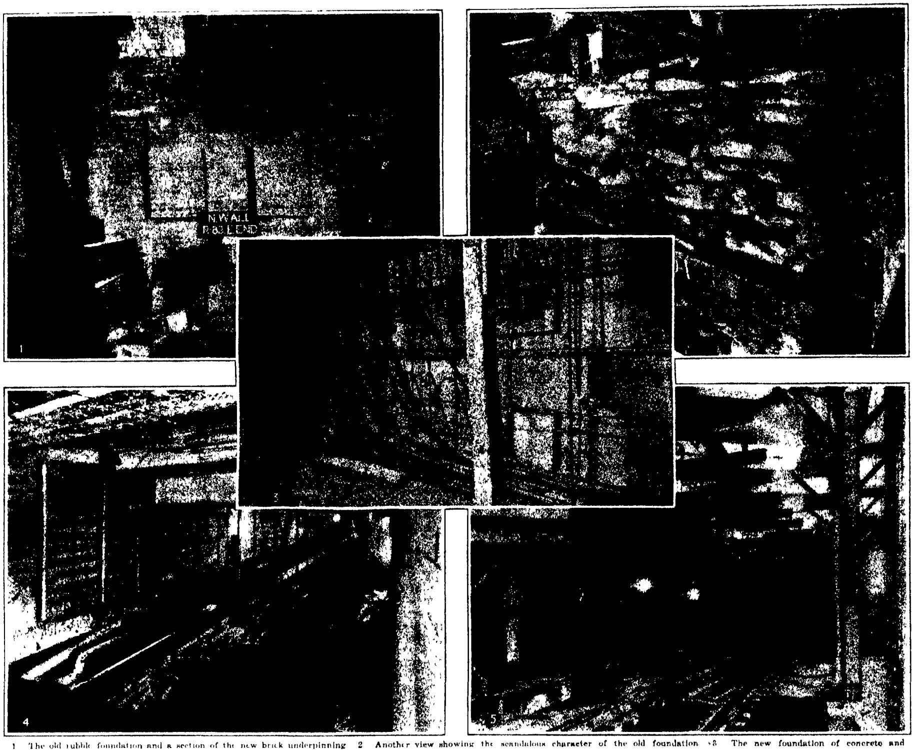


1 The old rubble foundation and a section of the new brick underpinning 2 Another view showing the scandalous character of the old foundation 3 The new foundation of concrete and brick, the steel needle-beams for transmitting the load of the building to the subway roof-girders, and the reinforcing rods for the concrete of the roof 4 One of the track bays, showing the steel work of the hanging gallery connecting the mezzanine floors also the five- and eight-foot piers, built at different times but in perfect alinement 5 Steel work for supporting the existing subway in Filbert St in connection with the under-crossing of the new tube

Building a subway under Philadelphia's insufficiently supported City Hall

Why Balloons Bounce Off Clouds

By Lieut. Corley P. McDarment

MUCH of the interesting and unusual phenomena observed by man since he has begun to traverse the "upper regions" has never come to the attention of the general public. This is largely because those who navigate the air soon become accustomed to strange incidents and after a short time begin to consider them commonplace and as facts of common knowledge.

For this very reason numerous interesting aerial experiences are discussed among those of the profession alone It will probably be many years before a large number of the so called "secrets" of the air are revealed to the layman who runs only on terra firma

One of these phenomena, and a remarkable one too, about which little has been said outside aeronautical circles, is the peculiar bouncing of balloons when they strike a cloud. It is rather an uncanny sight to see a balloon sailing gracefully along and encounter a large, fleecy cloud, when, as the gas bag touches and starts sinking into it, away goes the sphere like a rubber ball that has been batted Needless to say, a person has a weird sensation the first time he is up in a balloon and gets "bounced" in this way

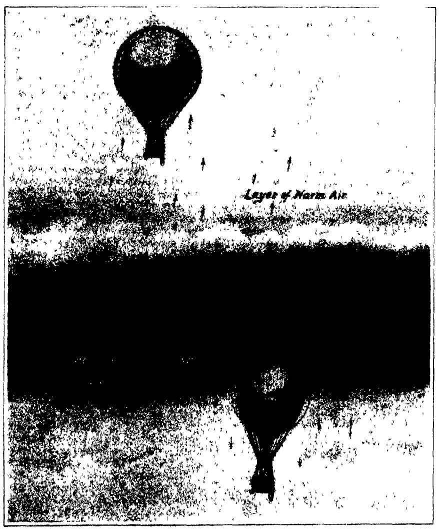
Airplanes sink readily and easily into the great masses of soft clouds, but balloons bounce off them like a rubber ball against the floor

A glance into the law governing this curious action discloses the fact that it could not happen otherwise unless several fundamental rules of science were changed The gases used in balloons, as everyone knows, are lighter than air and normally rise Omitting the discussion of why they rise, it can be said that the rising is on the same principle which causes cork to float to the top of water when it is released beneath the surface A piece of cork as it rises has a certain amount of upward pull which is directly proportional to the size of the piece A big piece will exert more upward pull than a smaller one, the quality of both pieces being the same This is true of all substances which are lighter than water If weights be attached to the pieces of cork, the large piece will buoy up the heavier weight, the difference being due to the size of the piece The reason why a large piece of cork will lift more weight under water than a smaller one is because of the difference in water displacement Likewise with balloons, a big balloon will lift more than a smaller one because of the air displacement. And this brings us right up to the "bounce" of balloons off clouds

It is well known that the air in clouds is cool and damp and it has been found by aerial navigators that just above the clouds there is a stratum of warm air This layer of warm air is caused by the radiation of the sun's rays from the clouds, and is similar to the layer of warm air that lies near the ground on a summer's day Now, when a balloon is released from the earth and there are clouds above, it goes rapidly upward until it strikes the cool air just inside the surface of the cloud, whereupon the gas in the bag is cooled suddenly, and in accordance with the law of gases, it contracts, or shrinks, and occupies a much smaller space In other words, the big balloon that started up has become a smaller one with less air displacement The moment this air displacement diminishes, the balloon drops precipitously just as a rubber ball that has been thrown against the wall or ceiling But, unlike the ball, it descends only until it encounters the warmer air near the earth where the gas is again heated and the balloon expanded When this occurs the balloon rises once more, and the process is repeated as before unless sufficient ballast is thrown out to neutralize the shrinkage of the gas bag. If this is done the balloon will rise on up through the clouds However, the moment it emerges on the upper side of the cloud the warm air layer existing there heats the gas and expands the balloon, and all the ballast that was thrown out below is now needed to check the too rapid ascent. This difficulty is overcome by letting out some of the gas

Having risen above the clouds, it is just as hard to get the balloon down again as it was to get it up. A reverse condition, with more danger involved, has to be overcome in "nursing" a balloon down through a layer of clouds When a balloonist high above the clouds desires to descend he lets out gas, thus diminishing the balloon's air displacement He comes down beautifully until his balloon encounters the warm air just above the clouds where the gas is suddenly heated up and the bag expanded then, lo, he has a big balloon on his hands when a moment before he had a smaller one This big balloon with its added lifting power shoots rapidly upward, giving all the appearance that it had "bounced" off the cloud It goes on up until it strikes cooler air again when the gas bag shrinks, and the aeronaut has a smaller balloon once more This little balloon will again descend and bounce off the clouds as it did before and will continue the performance until tactics are employed that are opposite those used in getting it up there Of course this would not keep on indefinitely as some of the gas is constantly being lost and the balloon would finally come down for this reason alone as soon as enough gas leaked out But, whenever an aeronaut wishes to "pilot" his balloon down through clouds, he releases a considerable amount of gas just as he enters the warm layer of air Immediately after this warm air is passed through and the balloon is within the clouds ballast must be thrown out with great alacrity because the cool air of the clouds will contract the gas bag so much that when it gets below it may be falling so fast that it will go on to the ground This is a dangerous thing, especially when the clouds are near the earth In a fog balloons often drop with a speed not calculated to be conducive to the good health and physical unity of mortal man But it is an effect that is con-

(*Continued on page 138*)



A balloon will bounce in either direction, up or down, when it meets a layer of warmer or cooler air that expands or contracts the gas in the bag

The Vacuum Tube as an Engineering Problem

By W. C. White

THE thermionic amplifier, three-element tube, vacuum tube, hot-cathode tube, valve, triode, audion, pliotron, etc., as it is variously called, is fairly widely used and its fundamentals known to a great many people In radio communication its use as a detector and amplifier is of great importance, and its use as an oscillator in radio transmission is rapidly increasing Acting in this latter function, it has many applications in other branches of electrical engineering and science

The fundamentals of the design construction and operation of the power tube or oscillator have been quite thoroughly worked out by the scientist and physicist In fact, at the present time laboratory accomplishments are far in advance of the product as regularly manufactured and used This condition is typical of almost every new device

One definition of engineering is "the art of constructing and using machinery Applied to the point in question engineering is required before the power oscillator tube can progress from the laboratory to the condition of giving widespread satisfaction in its everyday use Of these two steps the 'construction' is much the simpler and quicker because it can be concentrated in specialized groups trained and organized for the work

The second step, 'art of using,' is a very different matter It is in the hands of the many users and they are not usually particularly interested in the device itself, but rather in the function it performs or the service it renders Education is therefore necessary so that the user understands the many features of the device and an acquisition of this knowledge by large numbers of people takes time

This condition is not peculiar to the vacuum tube but is a common condition in the evolution of many engineering devices

As an example of this and as a device to use in comparison with the power vacuum tube, consider the rotary converter This device can produce alternating current electrical energy from direct current energy and thus fundamentally performs the same function as the power vacuum tube

In the way of design and construction, electrical engineering has slowly built up a method of specifying, describing and rating the characteristics of a rotary converter The user and manufacturer have commonly understood terms such as input A C voltage output D C voltage input A C current, full load D C current, speed, frequency of generated energy, regulation, excitation volts and amperes, kilowatts rating, allowable temperature rise of certain parts and many others A vacuum tube used as a generator of alternating current has many characteristics in common with the above and others peculiar to itself

However, these factors are as yet not usually understood by those planning to use tubes, nor are all of them as yet fully investigated or understood by the manufacturer

A rotary converter built without regard to these many characteristics would hardly be expected to function with entire satisfaction, yet that is usually the way vacuum tubes are used

Fortunately a vacuum tube is an exceptionally flexible piece of electrical apparatus and does remarkably well under different conditions

Now carry the comparison into the field of operation

The person operating the rotary converter even if not highly trained, knows a great many points in connection with its care He knows the bearings must be oiled that the windings must not be allowed to get wet, that grit and dirt are not good for the commutator, that a smell of overheated insulation is a sign of trouble and many others He knows that if with a normal output the input is abnormally high something is wrong and he will take steps to locate and remedy the fault

(*Continued on page 138*)

Pumping Coal from Mine to Seaboard

A Scheme for Shipping This Fuel via Pipe Lines, Much as Oil Now Is Shipped

By C. H. Thomas

A PROJECT to bring coal from the anthracite regions in Pennsylvania into the city of New York through two 14-inch pipes by water pressure has been put forward by Reginald P Bolton, A S M E Between New York and Scranton, Pa, there is a difference in elevation of about 2,000 feet and Mr Bolton believes that this would make it as easy to transport coal as water He claims 7,000,000 tons of coal could be brought through the pipe every year amply supplying the city's needs The general scheme is one that has been known for a number of years, and it has been tested sufficiently to demonstrate its undoubted success

One of the important effects of the establishment of a system of coal storage is the continuity of operation in the mining of the fuel It is authoritatively stated that about sixty per cent of the total annual coal production of certain fields is mined and marketed between the months of October and February, while only forty per cent is mined in the remaining seven months of the year This situation is mainly due to the difficulty of disposal of the fuel during the latter period, which could be advantageously utilized for the purpose of creating and replenishing fuel reserve stocks The loss to a single mine by an idle day is stated to average about $300, and in the case of large mines, would be as high as $1,000 The situation therefore in regard to the cost of coal could be beneficially affected by the establishment of reserve or storage in large quantities

The mining situation would also be substantially improved by the establishment of the pipe line system of transportation, because much of the present sporadic and irregular operation of the mines is due to the difficulties of car movement It is stated by an authority that it is rare for any mine to be able to work more than six out of eight hours on account of the difficulties of car service

The system of transporting coal with water in piping has been so far tested as to demonstrate its practicability On a small scale the system has been in operation in a plant in the city of London since the year 1915 This plant, which has a capacity of fifty tons of coal per hour, conveys the fuel a length of 1,750 feet through an eight-inch pipe having several bends, and raising the coal at the discharge about seven feet The cost of this operation is given as six cents per ton Some tests were also made in Chicago of this system which were considered to have established its practicability from a mechanical point of view. It may be assumed therefore that with proper consideration of the circumstances such a system could be practically applied to the transportation of fuel over a long distance, and that the circumstances would be favorably affected by the difference in level between a mining region and the seaboard, as in the case of the city of New York. It may be noted in this connection, that oil is now pumped over a distance as great as one hundred and seventy miles in California, through eight and ten-inch pipes, and over a distance of thirty-six miles in an eight-inch pipe line at a total cost per barrel of less than 04 cent

A study of the probable conditions and expense of construction of a coal transportation line from the Scranton region to New York indicates a probable investment of approximately twenty millions of dollars, and with all operating costs and fixed charges on a liberal scale, the cost of coal transportation would appear to be less than seventy-five cents a ton. It will be evident that there is a very substantial reduction in the expense of the transportation of the fuel to be anticipated by the use of water transportation, and that in addition the cumulative effects of this method of coal delivery, and of the establishment of a large storage would be to reduce the cost of operation at the mines, thereby effecting a reduction in the cost of production It may be fairly assumed that under existing conditions the establishment of this storage and transmission would reduce the price of fuel about $1 50 a ton

The recent car shortages have been responsible for the high prices of coal in all parts of the country. The output was not available when needed and the consumer had no assurance when it would be delivered. With the water system of delivering coal, a constant supply would always be available and the price correspondingly lower at all times, with the mines operating at full capacity.

As to the matter of preparing coal for shipment in this way it would have to be first pulverized, and mixed with water for transportation by pipe line. It is a well-known fact that coal from certain mines must be prepared for use and that the specifications for certain purchasers require this preparation. The preparation plant bears close resemblance to a standard ore-concentrating plant, being erected along the slope of rising ground to secure the benefit of gravity in the preparation of the coal. The shed-like building is about 200 feet wide and extends up the slope about 300 feet. At the upper end is the railroad leading to the mines, the coal generally being received into hoppers directly from the mine cars. At the lower end of the building is the steam plant, while along the valley a stream of water is to be found. Some distance upstream is a dam and reservoir, while some distance downstream in a large valley is the dump pile containing the impurities removed from the coal. A snake-like mound following along the bank of the stream covers the pipe line which carries the prepared coal to market. Adjacent to the plant are two large coal storage reservoirs Upon entering the plant at the point where the coal is received, we find large receiving bunkers under the tracks. These bunkers discharge the coal by gravity into large crushers, each of which is capable of reducing the coal to sizes not exceeding three quarter lump. These crushers and all other machines throughout the plant are electric-driven. The coal is then sent to the jigger, which is a washing

(*Continued on page 139*)

Little Things That Count Big

The Refinement of Details That Marks Our Present Railroad Development, and Some of the Further Needs

By Herbert T. Walker

IN these days, when our existence depends so much on mechanical appliances and especially on the machinery of transportation, it is a matter of great importance to improve, and, so far as possible, to perfect, even the smaller details of construction that go to make up our vast system of railroads

When our timber supply was ample, the cost of wooden railroad ties was so low that no one thought of making them of any other material The time is coming, however, when wood will not be available for this essential part of the track and a substitute will have to be found Steel ties have been tried, but they were noisy and there were other objections to them The indications are that concrete is the coming material and a simple yet safe means of fastening the rails to concrete ties should engage the attention of inventors In the meantime, so long as wooden ties are in use, there should be an improved way of securing the rails to them The time-honored driven spike pounded in by the track man's sledge hammer, crushes and tears the wood fibers In a short time, water gets in rots the wood and the spike then becomes free, losing its hold on the rail The natural consequence is that a heavy fast train will spread the track and a derailment, more or less serious, will result It is true that screw spikes are now in use but even these are not free from the defects of the driven spike, and at least one of our trunk lines is reverting to the old time method

We will now look at the locomotive It is the most self-contained form of the steam engine More time and study have been spent over its development than on any other form of motor The last few years have seen great improvements, making for efficiency and economy, chief among them being the water tube and fire-brick arch, feed water heating and superheated steam It is still, however, a wasteful machine Smoke box temperatures are far too high and much heat is blown out at the stack by reason of the powerful blast of exhaust steam required to urge the fire for rapid steam generation This sharp exhaust can only be produced by contracting the area of the exhaust steam pipe by what is known as a "blast nozzle" This device may be classed as a necessary evil, insomuch as the more we restrict the area of the blast nozzle the greater will be the back pressure on the pistons, limiting the power and speed of the engine to a serious extent

Many forms of blast nozzle have been tried, and as far back as 1838, Brunel and Gooch applied a short pipe, having an opening shaped like a Maltese cross, to an engine on the Great Western Railway of England This nozzle increased the area of steam exposed to the gases from the fire, thereby strengthening the draft without choking the exhaust steam from the cylinders Like some other inventions, it was in advance of its time and was abandoned. There is a good field for the inventor in the way of producing a *variable* exhaust pipe which will pull the draft through the fire without excessive back pressure, and it would seem practical to design some way of reducing the area of the blast nozzle when starting the engine, for at that time the volume of exhaust steam is comparatively small and back pressure negligible. As the engine gained speed, the blast orifice could be expanded and back pressure greatly reduced This could be done either by the fireman or made automatic by a simple connection with the reversing lever of the engine

When the electric locomotive is drifting or running with the power shut off, the current generated by the motors is transmitted to the feed wires and helps to haul other trains This operation also retards the train and saves a lot of energy otherwise spent by the air brakes This is known as "regenerative braking" and is a feature much emphasized by advocates of electric traction The system cannot be applied to the steam locomotives, but some arrangement by which the energy now wasted in stopping the train could be saved and the train's momentum stored up to assist the engine when starting would be a great advantage, especially in the case of trains making frequent stops It is suggested that, by some suitable arrangement of suction and discharge valves and a connection with the reversing gear under control of the engineman, the cylinders could be converted into air pumps, forcing air into a receiver either on the engine or tender. When starting the train, this air could be used in a supplemental motor geared to the trailing wheels of the engine. This would greatly assist the locomotive and would shorten time between stations. If found objectionable to draw cold air into the cylinders, especially in the case of superheated locomotives, the supplemental motor could be used as an air pump, converting it into an air driven engine when starting the train. This auxiliary power would not use any steam and should be worthy of a trial.

If a car journal or journal-box breaks the car will be derailed with more or less serious results. It is suggested that an emergency journal box be fitted to the axle and truck just inside the wheel. This box would only come into use if the main journal failed.

There is room for improvement in the way of ventilating our passenger cars. It is the same today as it was fifty years ago. The transoms in the clere-story roof cause down drafts and have to be closed in cold weather The only way to get fresh air, if the transoms are closed, is by opening the windows and letting in a shower of dust and cinders This may not inconvenience the person occupying a seat at the window, but to one sitting in the next seat behind it is often a nuisance, as people's ideas of temperature and drafts differ widely. Pullman cars are provided with outside window shields which break direct drafts, but day coaches have no such convenience. It would appear practical to devise a small fan-shaped screen of strong flexible material that would fold back into a recess in the window casing when not in use. If one of these screens were installed directly over the back of each seat, a passenger not desiring to sit in a draft could pull out the screen and fasten it to the back of the seat in front of him, thus protecting himself and giving the person ahead the full benefit of the wind.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Thousand-Dollar House and Its Near Relatives

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 11, 1920, you have an article by Mr. Mount, "A Review of the Building Situation," etc. In separate box you ask, "Can a house be built for one thousand dollars, and how?"

I am enclosing a plan for a permanent house that can be built for one thousand dollars. The walls, 18 x 30, are to be built with hollow concrete wall construction The floor space is 540 square feet The walls are nine feet high, the ceiling eight and one-half feet high. Cement foundation, floor and steps are provided. Ceiling is wood lath and plaster. Roof is covered with composition roofing. The house will accommodate six persons—four very comfortably, but six can get along fine. Two very good sized rooms with space between for closets, toilet, sink, shelving, cupboards, two closets for closet-beds (rolled in on end), pantry and plenty of room for necessary articles

The wall is built a story at a time in one operation, there being a complete air-space from foundation to plate for the entire circumference of the walls This provides a wall that is cool in summer and warm in winter A wall which will exclude moisture and vermin Plaster direct on the inside wall.

The cost of this house is based on cost of material and labor here To wit: carpenters, $8 00 per day; plasterers, $12.00; common-labor, $5 00, lumber, $47 00 to $80.00 per thousand; rock, $3 00 per yard, sand, $2.00 per yard; cement, $4 00 per barrel; wire lath, 54c per square yard, reinforcing rods, 8c per pound, and painters, $8.00 per day

One of the houses we have built this year was rented in March at $25.00 per month for one year I give you cost, as I kept books, and will just itemize it for your benefit. Carpenters, $253.44, lumber and doors and windows, $890 85, drayage, $31.00, chimney work and all, $7.80; material, labor, cement, etc, $608.22; plastering inside and outside, $270 00, painting, $147.00; wiring, $38 00; fixtures, $26.50; plumbing, $885 00; linoleum and shades, $36.00; steps, caps, porch and porch wall, $109 60, locks, hinges and screens, $49 75; cesspool and ditches, $30.00; roofing, $64.00; sand, rock, etc, $87.29; piping gas from alley, $26.05, clothes hooks and hedge bushes and cleaning floors, $8 40. Total, $3,068.90. The plumbing consists of toilet, double wash trays, bath tub, sink, hot-water boiler, lavatory, drain-tile for sink, and yard piped for watering lawn.

J. R. RICHARDSON.

Madera, Cal.

Built: An Inexpensive House

To the Editor of the SCIENTIFIC AMERICAN:

In the December 11, 1920 issue of the SCIENTIFIC AMERICAN there appeared an article under the head of "Wanted: An Inexpensive House." The author gave a number of very timely suggestions on the building subject, but as the Editor remarked, our housing problem yet remains unsolved. It is to this end that this article is being written.

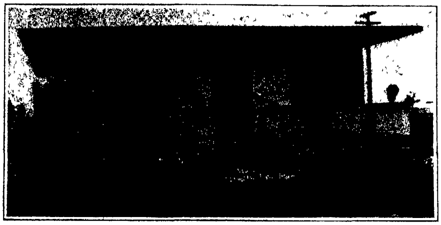
The Editor also asked if any of his readers could solve the $1,000 house problem. The subject was stated in such a way that it was impossible to tell whether he wanted to know if a house could be built for $1,000, or if a man having $1,000 could build a house, and borrow enough to see his undertaking completed.

Within the last four years I have built two houses, the smaller one being a house for less than $1,000; the other, an eight-roomed house, may be classed as an inexpensive house, being built between May 30, and September 15, 1920, and costing less than $3,000.

I am only 26 years old, and do not consider myself to have any more than ordinary ability in any particular line whatever, and what I have done, I feel sure others may do also, if they have the necessary ambition to go ahead and stay with the undertaking and see it through

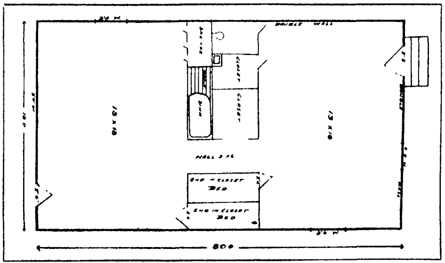
In 1916, just after getting married, I found myself in the same position as so many people are today I had very little money, but decided that I must have a home of my own I got a catalogue from a houses-to-order firm and decided to build one of their models, with certain changes I made in it after it arrived The 6 x 17-foot porch was not included with the ready cut house, neither were the stairs at the end of the living room After putting in the stairway, I floored the attic, which proved to be an excellent place for trunks and the like. This house cost me at that time (September, 1916) completely finished, $400

In 1920 I put on an addition, fitted the house with electricity and built the chimney, for $200 more This house is very comfortable and of exceptionally good material and still cost less than the $1,000 Even now, making the allowance for the increase in wages, freight rates and cost of material, I think this house can be erected for less than $1,000 Any man, with the aid of one experienced carpenter, should be able to build a house of this kind in two weeks



This house, of similar construction to the thousand-dollar one diagrammed below, but considerably more elaborate in construction, cost, including the bushes for the hedge and all the other trimmings, barely $3,000

But you may say that what was done then cannot be done now You know as well as I, that when a man contracts to build a house for you, he must figure his profit high enough to cover all expense, whether known or unknown at the time of the contract, and still allow himself a handsome reward for his labor But if you have the ambition to tackle the job yourself and see it through, you can build a house for about one-half what a contractor would ask This house was built at a time when labor was at its highest, prices on material were high and material was hard to get at any price



Floor plan of a concrete house that was built for $1,000

About the first of May, 1920, I found that it was going to be necessary for me to build another house. At the time I had a lot to my title and about $1,200 in sight. I wrote for catalogues of ready-cut houses, but not being able to find anything quite to my liking, also began to draw plans of my own and compare prices with lumber companies I went to a carpenter and asked as to the amount of time that one might save in buying a ready-cut house, and he advised me that a man could cut his own lumber quicker than he could hunt for the material in a ready-cut house. I decided then to build from raw material, if I could come anywhere near the price of the ready-cut dealers.

I went to a local lumber company and asked about what it would cost me to build a house, over the plans I had drawn They informed me that they did not take contracts, but that they would get in touch with a local contractor and give me his estimate in a few days Just as I was about to turn away, the proprietor of the company asked me: "Why don't you boss the job yourself? I'll give you prices on the different materials, and send all you want to the job and what you don't need I'll take back" I told him I would think it over and he was to let me know what the contractor's estimate was in the meantime

I again returned to the carpenter for advice and told him just what the lumber man had said He made out a list of the material it would require to build a four and an eight-roomed house on the same size foundation and then told me to see what kind of an estimate I could get on that amount of material He also agreed to build the house, hire a helper and see that it was put up right for a certain sum per day I returned to the lumber man with the list of materials and to my surprise found that it would cost only about $500 more to build an eight-roomed house than it would a four, so I decided that it should be an eight The contractor wanted $6,000 for the job, so I told him that I would boss the job myself.

I began digging my cellar, which was to be 24 x 24, on May 30, and by the last of June I had it ready for the bricklayer I did my digging before and after working hours Then my next job was to find a bricklayer Fortunately I found one who would have an off day on the following week, and he said that if I would have the necessary materials on hand, that he would bring a helper and tender and finish the job on that day It required 554 tile at 32 cents each, 13 sacks of cement at $1 each, and about 40 bushels of sand at 25 cents The labor on that job amounted to $36, so the cost of the foundation, less my own labor, amounted to less than $250

Then the carpenters came on to the job Every day I would 'phone the lumber company of my needs for the following day It just required four weeks and three days of actual carpenters' labor to finish the job One more day was required of the bricklayer and his two assistants to build me a chimney, having three flues, one of them having special liners running down to the cellar for a furnace This chimney required 2,500 bricks, and the labor on the job cost me $28

The roof of the house was made of composition shingles, well nailed with copper nails I used plaster board on the walls, instead of plaster, as that represented a saving of about $200 The wiring I did myself, and this saved several dollars The paint for the building was purchased from a local painter and I put that on after working hours

With the painting, spouting and everything finished, I figured up my bills and found that it was only necessary for me to borrow $1,620 to clear all debts The lumber man gladly went my security for this amount The entire amount of money spent on this house, from the time I started to dig the foundation, until it was ready for occupancy, was $2,838 22 The material, not including the chimney, from the foundation up, amounted to a little over $1,700 And prices of things were at their highest at that time

Just a word about the plans, before closing We have five large closets, an especially large one over the stairs, which in most houses is only lost space. In the whole plan you find not a single square foot of lost space anywhere

As for arrangement, I do not see how it could have been improved upon, without the expense of an extra chimney

A J McCLOY

South Brownsville, Pa

Motor Fuel in Great Britain

UNDER the pressure of high prices and a scarcity of motor fuel in Great Britain new laboratories have been provided to study the possibility of substitutes. This is under Prof. H. B. Dixon, who will begin his work with alcohol produced from vegetable materials.

How We Think

The Microscopic Structure of the Intellectual Portion of the Human Brain

By Leon Augustus Hausman, Ph.D.

ONE of the most interesting and significant revelations of the modern study of the structure of the human brain is that there exists an extremely intimate association between the structure of that organ and the various aspects of thought, emotion and other mental phenomena. It is now a well established fact that all mental processes are explainable upon the basis of brain structure and activity. No mental activity can be carried on without brain-cell activity. The experiencing of sensations and of emotions, the perception and remembrance of objects, the formations of judgments and the construction of long and intricate trains of complex reasonings, in short all the varied operations of the mind of man are necessarily bound up in the operations of the brain. Complexity of brain structure means complexity of mental activity.

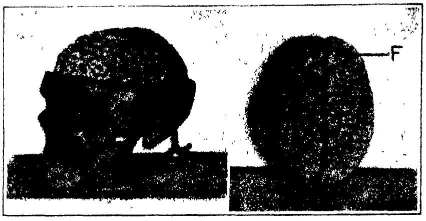


Fig 1. The cerebral hemispheres in place in the skull the upper portion of which has been removed to render their contents visible

Fig 2. The hemispheres, seen from above. *F* indicates the frontal region, where the active thought phenomena are localized

Two views of the cerebrum, or thinking portion, of the human brain

In view of this close association between mental phenomena and brain action, it is logical to expect that a close parallel exists between the general intelligence of any given human being and the structural development of its brain. The researches of many able scientists in the field of brain structure and development have resulted in the accumulation of an array of facts whose correlation and interpretation enable us to establish, with tolerable certainty, the *main features of the laws of relationship between intelligence and the brain*. We may say at the outset that intelligence is the result of the growth of *certain minute structures in the brain*.

The study of this relationship of brain matter to intelligence may be pursued in several ways. We may endeavor to correlate degrees of intelligence with degrees of weight of the brain mass as a whole, or we may endeavor to discover the relation between mental growth and the growth of the structure of the brain. The latter field of research has proved the more fertile of the two, particularly the study of those physiologically ultimate elements of the brain structure, *i.e.*, the nerve cells or neurones. Cells are the units of living matter built up into bodies, very much as bricks are the *units of structural matter that are built* up into buildings, bridges, etc. The cells of the nervous system are known as nerve cells, or neurones. They differ considerably in various portions of the nervous system but their fundamental structural characteristics are all similar. Figs 5 and 6 show two of these nerve cells, or neurones, from different portions of the brain.

The human brain, built up of millions upon millions of neurones, is a bulky structure, weighing normally about fifty ounces in the adult. It consists of three main masses, each with various subdivisional parts, known as the fore brain, *mid brain, and hind brain*. In man the fore-brain is the largest of the divisions weighing about forty four ounces. It is made up of two large convoluted masses known as the cerebral hemispheres, or collectively as the cerebrum (Figs 1 and 2). The mid brain forms a sort of connecting link between the fore brain (cerebrum) and the hind brain. This latter portion of the brain consists of a large mass directly beneath the hinder portion of the cerebrum called the cerebellum, a smaller mass, directly in front of this known as the pons Varolii or simply the pons, and an elongated downward projecting pear shaped mass, which tapers out into the spinal cord, and is called the medulla oblongata, or the medulla. Like the spinal cord, the brain itself consists of both gray and white nervous matter. The greater portion of the gray matter is spread over a large part of the outer surface of the brain, but small masses of it are likewise to be found buried in certain parts of its white interior. By reason of the numerous folds and convolutions present in the surfaces of the cerebellum and particularly of the cerebral hemispheres, the area over which this layer of gray matter is spread is very greatly increased.

This layer of gray matter over the outer surface of the cerebrum is known as *the cerebral cortex* (C, Fig 3), and it is this portion of the brain, and particularly that part about the frontal region of the cerebrum (F, Fig 2) which is most closely associated with those operations of the mind which we call the higher, or intellectual, functions.

The cerebral cortex, to which we shall confine ourselves, contains countless millions of nerve cells, or neurones, of varying forms. However different may be their configuration, each one consists of a central portion, known as the cell body (B, Fig 6), and branches, called fibers (D, Fig 6). In many of these cells these fibers may be extremely long, and branch many, many times, giving rise to a very complicated, root-like structure. The numerous *ramifying branches* of the nerve cells connect with each other, and with the branches of a host of other nerve cells, and send out fine "tendrils" and "rootlets" into remote portions of the nervous system.

The neurones of the cortex are arranged in several rather well defined layers, each layer containing neurones of a characteristic shape (Fig 4). The thickest of these layers are called the layers of the pyramidal cells (P and P_2, Fig 4) or neurones, since they contain neurones whose general shape is pyramidal. The pyramidal neurones are so placed that their acute apices are all directed outward toward the surface of the cortex, with their broad bases facing the central portion of the cerebral hemispheres. A correlation of the various studies made upon the microscopic structure of the cerebral cortex indicates that it is these pyramidal neurones which, *more than any of the other cells* of the cortex, are associated with the higher mental processes.

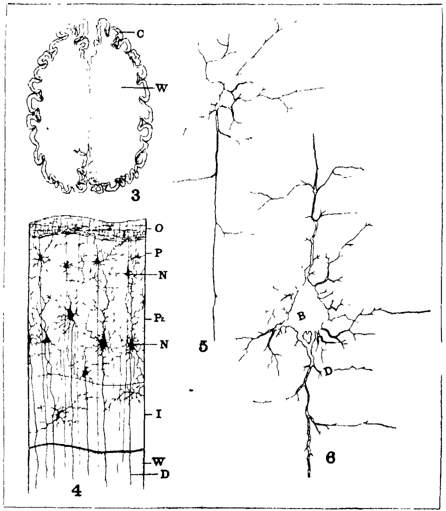


Fig 3. Cross section through the middle portion of the cerebral hemispheres, to show the thickness of the cortex where the thinking cells are located. *C* represents the cortex, *W* the white matter of the interior of the brain. Fig 4. Highly magnified section through the cortex. *O* is the outer layer. *P* and *P* layers containing, respectively the small and large pyramidal cells, the "thinking cells." *N* is a single pyramidal cell or neurone. *I* is the inner layer of the cortex containing very few cells. *W* is the white matter of the interior of the brain. *D* are the dendrites, or fibers from the neurones, that lead into the interior of the brain for the purpose of forming connections. Fig 5. A single nerve cell or neurone from the outer layer of the cortex with some of its principal fibers. Fig. 6. One of the most important of brain structures, a large neurone from the second pyramidal layer of the cortex, showing the mode of branching of some of its dendrites. *B* is the cell body, *D* the dendrites or fibers

The minute structure of the cerebrum, or thinking portion of the human brain

From the standpoint of comparative development of brain activity among animals it is significant to note that here also a definite relationship has been observed between the degree of intelligence possessed by an animal and the number and development of the pyramidal neurones. Not only in animals of superior intelligence do the neurones become more numerous, but also larger, and, moreover tend to develop longer fibers, which branch more abundantly. This results in an increased number of contacts made between neurones. In fine, we may say that the intelligence of a species is dependent upon its brain development, particularly upon the development of the pyramidal neurones of the frontal portions of the cerebral hemispheres. And the particular sort of change which we would characterize as *development*, in this sense, is chiefly an increase in the size of the cell bodies, and in the length and number of branches and interramifications of the nerve fibers.

In the human species, as well, the development of intelligence and of the pyramidal neurones of the cortex show the same parallelistic course. Researches in human embryology (the study of the child from conception until birth) has brought out the interesting and significant *fact that the number of pyramidal cells* in the cortex goes on increasing until the third or fourth month of foetal life. Beyond this period the number *does not* change. This means that the number of cortical cells of this type with which any given individual is endowed is fixed well before birth.

After the third or fourth month of foetal life, and during all the subsequent existence of the individual, the principal changes which take place among the pyramidal neurones are increase in size, texture, and in the length and ramifications of the nerve fibers. As the individual grows through childhood to maturity such are the changes which take place. It has also been noted that with develop-

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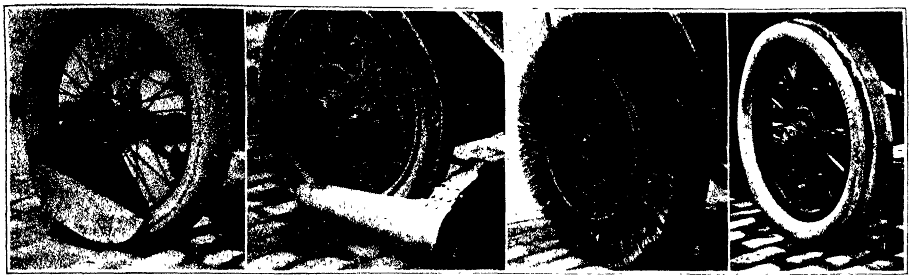


Four ingenious devices that are being tried out in Paris with the intent of preventing the indiscriminate splashing of mud from the automobile wheel

Novel Aids to the Mud Guard

THIS is the season, or if it is not it soon will be, when the automobilist and the pedestrian so unfortunate as to be forced near a moving car are united in their realization that one of the evils of automobiling is mud. The pedestrian comes home with mud flung upon him from puddle and bog-hole, while the car driver reaches his garage with a heavy coating of real estate over his wheels and the underbody of his car. Both parties would doubtless be grateful for anything that would abate this nuisance.

One way to abate it, of course, is to abolish the mud. We fear that it will be some time before our roads are all so built and so maintained, however, that the waters of springtime, and especially the fraction of these waters that results from the thawing of the roadside, will cease to have their accustomed softening effect.

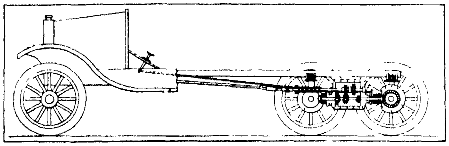
If we can't abolish the mud, the next best thing to do is to insure that it stays where it lies, *so far as* possible, instead of developing a fond attachment for every car that passes through it. We illustrate four novel devices that are intended to bring about this ideal state of affairs. These were all shown at a recent exhibition of anti-splash apparatus in Paris. The first one recognizes the tendency of the wheel to lift mud and fling it, but tries to regulate that tendency by providing a passageway for the mud to shoot off backward and low, instead of going high and to the sides. Two plates are suspended from the hub in such fashion as to form a narrow channel through which that part of the tire in contact with the road revolves.

A second attachment that works in the same general manner, but that it seems ought to be somewhat more effective, is the low hung guard shown in our second view. This, however, would be a pretty poor reed on which to lean if the car were to be driven over some of the famous mud-infested roads of America. It wouldn't take much of a rut or hole to snatch the guard *clear off*.

The photographer assures us that the brush of the third view is designed to revolve with the wheel. If means were offered for attaching it to a dead member of the axle *or to* some other dead part of the car, we should have more faith in it. As it is, it seems to us that it is open to the same objection as the first scheme, only more so. We cannot help picturing the shower of mud that would strike out in all directions from this brush, once it got thoroughly saturated with earth and water.

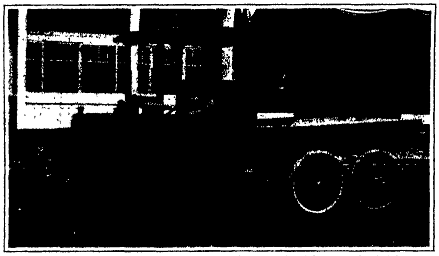
The final view is not of a tire of freak shape, as might at first glance appear; the member at the outside is quite separate, being a rubber shield that revolves with the rim. From 3,000 miles away this looks to us like the best of the four models. It seems to us that this shield might well be expected to lay down, gently and without much splutter, the mud that it picks off the wheel.

The Six-Wheel Truck with Four-Wheel Drive



Vertical longitudinal section of the four-wheel-drive six-wheel truck

MANY advantages are added to the use of motor trucks by the recent invention of H. P. Suhl of Kissimmee, Fla. This invention comprises an attachment for converting an ordinary passenger car into a truck of the sort suggested by the above head. As a beginning the device is being manufactured only for use with the small car, but later it will be made for touring cars as well.



Passenger car converted into a six-wheel truck with four-wheel drive

The drive *attachment constituting the present* invention is secured to the rear portion of the car to which it is to be applied. This attachment includes two parallel axles, each having a differential. Bearing members are extended toward each other from the respective casings and are bolted or otherwise secured to the respective ends of a gear casing which is supported between the axles. This casing is braced so as to provide a strong and durable connection between all the *parts*.

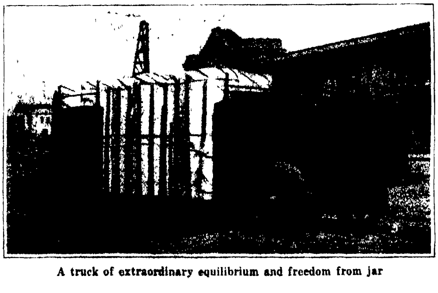
Extending longitudinally and journaled in bearings is a shaft provided at its ends with gears which mesh with the annular gears of the differentials. Fixed to the shaft and housed in the case are other gears arranged so as to secure the desired reductions, when meshed, respectively, with the gears of another set in a sleeve on a second shaft journaled in the top portion of the case and connected by a universal joint to the transmission shaft of the vehicle. A grooved flange or collar is formed on the sleeve, and is engaged by a forked arm formed at one end of a sliding rod. The latter rod extends forward from the gear case and is connected by universal joint to an operating rod which can be connected to a hand lever for shifting gears.

In every instance when the gears are

(*Continued on page 139*)

The Front-Wheel-Drive Truck with Low Clearance

THE truck which we illustrate here might almost qualify for the freak class, so far as appearance goes, but a catalogue of its distinctive features indicates that such classification might be an injustice. The tractive effort is on the narrow front wheels, the model driving with these alone and using the rear wheels for followers only. According to the designer this represents an effort to get back to the principle that ruled when the horse went before the cart. Of less doubtful value is the suspension of the engine from an entirely independent set of springs, intended to remove it from all exposure to road shock. *Steering gear* and brakes are of the hydraulic type. We are not informed whether the steering is done with the front wheels, or whether these are on a rigid axle to facilitate the front wheel drive, with the steering left to the following wheels; either arrangement it appears would have its advantages and its drawbacks. The most striking feature is the low-hung body. This is obviously made possible by the peculiar arrangement of the engine suspension in company with the front wheel drive scheme. It is, of course, an entirely sensible notion, having done away with the necessity for running a drive shaft down the center of the vehicle at the height of the rear axle, to depress the body to occupy the space thus vacated. Certainly this truck would be the last one in the world to overturn, and if its other novel features will *stand the* test *it ought to be of* much value in many special kinds of service.



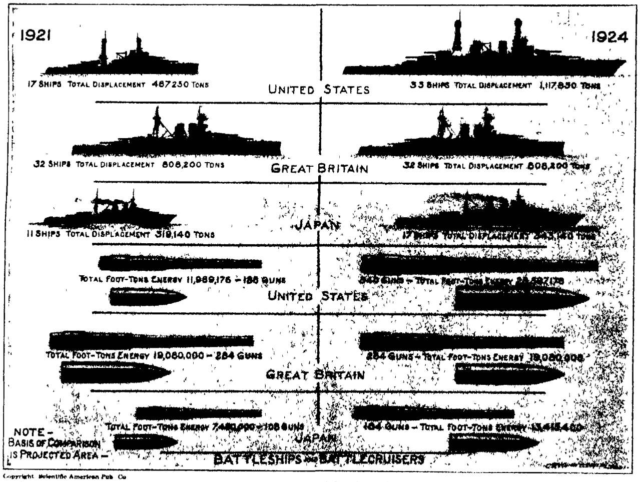
A truck of extraordinary equilibrium and freedom from jar

Leading Navies Compared

First Line Fighting Strength Today and in 1924, When Ships Now Building Will Be in Operation

THE foundation of the strength of a navy is what is known as its "first fighting line," and the backbone of this fighting line is of course its capital ships—battleships and battle-cruisers Associated with these capital ships in a properly constituted fleet are many other vessels of various types—cruisers, scout-cruisers, destroyers, flotilla leaders and submarines Our diagrammatic comparisons include only the battleships and battle cruisers of the United States, Great Britain and Japan For reasons which we give later, the comparative fighting value of the three navies as shown in this way may be considerably modified by the character and number, in each navy, of smaller but very numerous and highly necessary types of fighting ships Furthermore, as regards the capital ships alone, it must not be considered that the mere totals of numbers, displacement and gunpower give a literal standard of comparison of the actual efficiency of these fleets There are many other factors affecting this efficiency, such as the individual size of the ships, their defensive armor, their internal subdivision, their speed, their maneuvering ability, their radius of action, and, lastly and more important than all the previous considerations put together, the quality of the personnel

We have heard a great deal of talk recently about the race in armaments, and the impression unfortunately has gone abroad that the three great navies are feverishly building up their fleets in competition with each other to secure the so called supremacy of the sea This is not true of one of the great powers, Great Britain For immediately upon the defeat of Germany and the sinking of the German ships at Scapa Flow, Great Britain, shut down on construction of the battleships and battle-cruisers which she had in hand at the close of the war Her naval construction has been confined to the completion of some cruisers, scout cruisers destroyers and submarines which were so far advanced that it was deemed more economical to complete them than to have them broken up The only work she continued on capital ships was done in completing the battle-cruiser "Hood," a 42,000 ton, 32 knot ship She was from sixty to seventy per cent completed at the armistice, and has since been completed and put in commission There were three sister ships to the 'Hood' building at the time of the armistice and these three were broken up These facts will explain why, in the comparative tables for 1921 and 1924, the same figures occur so far as Great Britain's navy is concerned



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Comparison of capital ship (combined battleship and battle-cruiser) strength of the United States, Great Britain and Japan in 1921 and 1924

Comparison of Battleship Strength

Battleship construction, then, is confined to the United States and Japan At the present time, including the "Tennessee which has just been completed and the "California, which is practically completed, our Navy includes 17 battleships of 467,250 tons displacement, which mount 188 big guns of 12-inch caliber and up, whose total muzzle energy is 11,989,176 foot-tons We have under construction 10 battleships which are in various stages of completion Four of these are of 32,600 tons displacement, 21 knots' speed and mount eight 16-inch 45-caliber guns, firing a 2,100-pound shell with a muzzle energy of 99,000 foot-tons These four ships are from thirty-five to eighty-five per cent completed. Also we have six ships under construction, which are of 43,200 tons displacement, 23 knots speed, and are armed with twelve 50-caliber, 16-inch guns, firing a 2,100-pound shell with a muzzle energy of 112,000 foot-tons These six ships as yet have had relatively little work done upon them. The average of completion of the hulls is about 8 per cent, and the total work on the ships and their equipment is about 12 per cent The total cost of these six ships when they are completed will be at present prices about $400,000,000

When the 10 ships have been completed we shall possess 27 battleships with a total displacement of 856,850 tons mounting among them 292 big guns, the total muzzle energy of which will be 23,221,176 foot-tons These figures may be compared with those for the British navy which, today and in 1924, will possess 26 ships of 632,700 tons displacement, mounting 240 big guns, with a total muzzle energy of 15,906,000 foot-tons.

Japan at present possesses seven completed battleships of 200,140 tons displacement, mounting 76 guns with a muzzle energy of 5,374,400 foot-tons She has two battleships under construction, and in 1924 will possess a fleet of nine battleships of 273,140 tons displacement, mounting 92 guns whose total muzzle energy will be 7,070,400 foot-tons It should be explained here that two battleships which Japan is now building represent all of her actual battleship construction They form part of a program of four ships, the "Kaga," "Tosa," "Nagato," and "Mutsu" Of these the "Nagato" has been completed and the "Mutsu" is practically completed, and we have included her among the finished ships. The other two, the "Kago" and "Tosa," were begun in January, 1920 These ships are somewhat similar to the four ships of our "Maryland" class. They are of 32,000 tons displacement and mount, like our ships, eight 16-inch, 45-caliber guns A program of four additional battleships has been projected, but no appropriations have been made and therefore they do not figure in the present comparison

Comparison of Battle-Cruiser Strength

At the present time the United States possesses no battle-cruisers, although six have been appropriated for and are now under construction. Very little has been done upon them, the keels of three of them not having been laid until toward the end of September last year. At the present writing a rough average of about 5 per cent represents the work done. They will be the largest ships in our own or any other navy, and in common with our new battleships which have been recently illustrated in the columns of the SCIENTIFIC AMERICAN, they will be very handsome ships. The displacement will be 43,500 tons and each will mount eight 50-caliber, 16-inch guns similar to those on our new battleships. Their total displacement will be 261,000 tons, and among them they will mount 48 guns with a combined muzzle energy of 5,376,000 foot-tons Their length will be 874 feet, and they will have a speed of 33¼ knots, which is higher than that of any existing battle-cruisers.

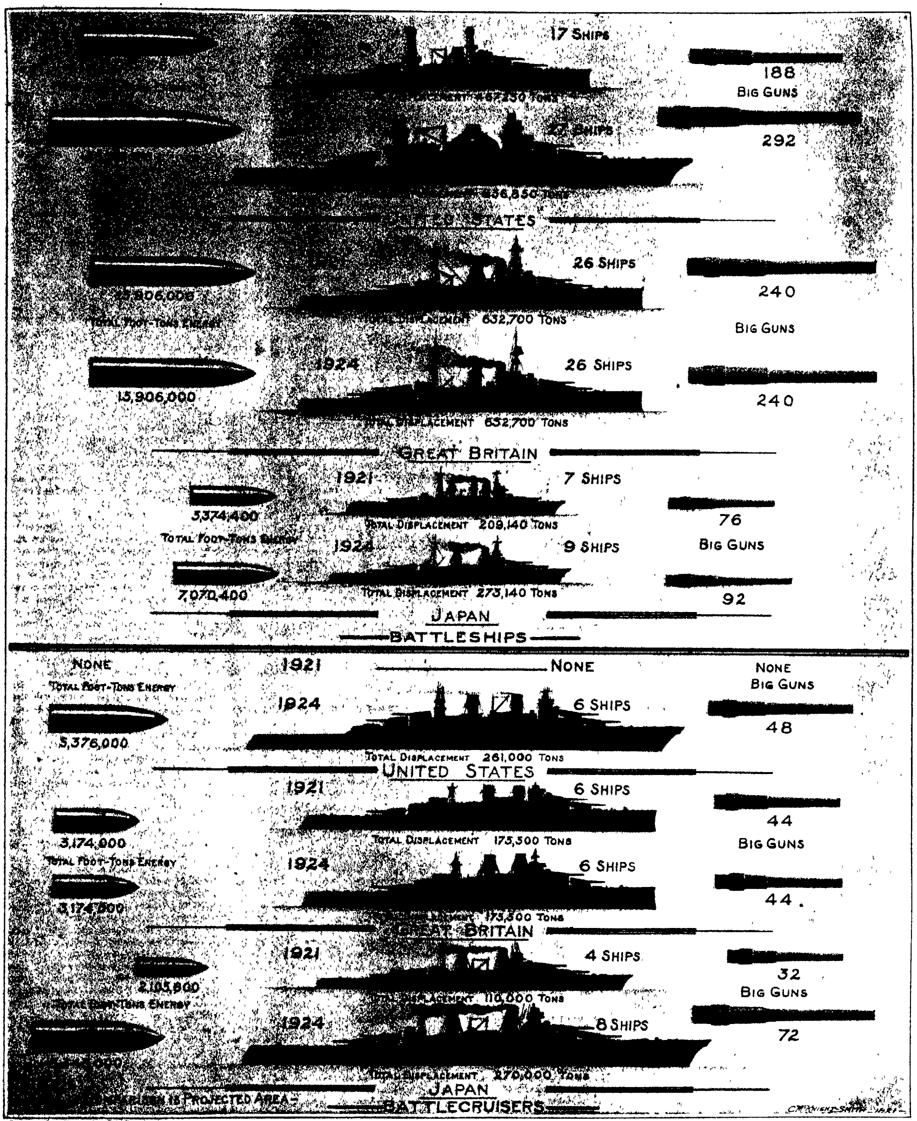
Great Britain possesses six battle-cruisers fit to lie in the line, led by the "Hood," of 42,000 tons. They have a combined displacement of 175,500 tons and mount 44 guns of 13.5 and 15-inch caliber whose combined muzzle energy is 8,174,000 foot-tons. As Great Britain has no battle-cruisers under construction, her totals for 1924 will be the same It should be noted that no ship with armor 6 inches in thickness, or less, is reckoned as a battle-cruiser

Japan evidently sets a high military value upon the battle-cruiser, for it is her intention in the future to build a battle-cruiser for every battleship that she sets afloat. At present she has four completed battle-cruisers, the well-known ships of the "Kongo" class, with a combined displacement of 110,000 tons, mounting among them thirty-two 14-inch, 45-caliber guns, whose total muzzle energy is 2,105,500 tons. She has at present under construction four battle-cruisers, the "Amagi," the "Akagi," the "Atago," and the "Takao" These will evidently be large ships, comparable to our own battle-cruisers. The displacement has been given as 40,000 tons; but in view of the fact that each is to mount ten 50-caliber, 16-inch guns and that they are to have battle-cruiser speed and armor, it is difficult to see how this can be done on such a displacement. If 40,000 tons is the limit, then either the armor or the speed, or both, must have been sacrificed.

We understand that the boiler and engine room equipment is for a contract shaft horsepower of 135,000. If so, and the ships are to carry ten 16-inch guns (and we have the very highest authority for the statement that they will), the speed cannot be much over 30 knots On the other hand, we have heard from rather authoritative quarters that the engine room output will be over 200,000 horsepower. If the latter estimate be correct and the armor plan matches the tremendous battery, these ships cannot be of less than 45,000 tons. Time will show; but it may be taken as certain that the 10-gun battery is correct. As to the progress of these ships, the "Amagi" was begun in September, 1920, the "Akagi" in October, 1920. The keels of the other two ships have not yet been laid. There has been talk of four additional battle-cruisers, but, as in the case of the additional battleships, no authorisation or appropriations have been made by the Japanese government, and the whole eight ships may be considered as merely on paper.

Summing up for the three fleets, we find that in 1921 the United States has 17 capital ships, Great Britain

(*Continued on page 139*)



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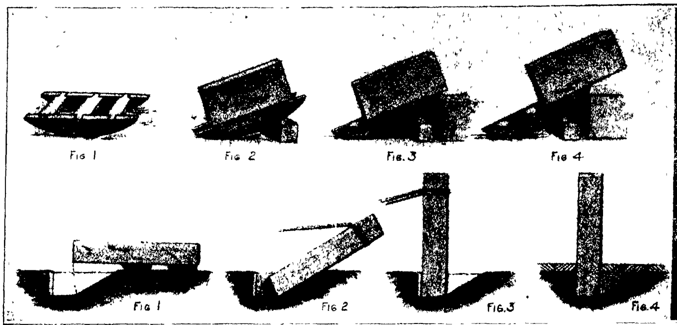
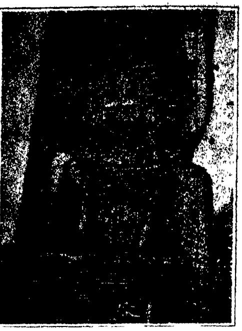
These diagrams show the comparative strength of the United States, Great Britain and Japan in 1921 and 1924. The upper diagrams show battleship strength, the lower, the battle-cruiser strength. Note: This comparison includes only ships built, building, or for which money has been voted





Above: Four successive stages in the elevation of a big stone by means of the rocker. With the rocker in the position of Fig. 4, it is possible to elevate the lower end to a false-work support higher than the first one, and proceed to the next stage. *Below:* Four steps in the erection of a tall column or obelisk with the aid of a trapezoidal shaft. *Right:* A detail of Egyptian sculptural ornamentation

The Engineers of Ancient Egypt

Mechanical Devices Used in Constructing Pyramids and Erecting Obelisks

By G. A. McWilliams

THE old-fashioned answer to the query, "How were the pyramids built?" consisted in vague references to untold millions of slaves, with the implication that the amount and the vastness of work which can be accomplished vary directly as the number of people who can be put to work. The better engineering judgment which our historians possess today makes it clear to them that this is not the case, and that it really is necessary to account for the ability of the Egyptians to perform the tasks which they did perform. Engineering apparatus of some sort they must have had, or the labor of their countless slaves could not have been sufficiently concentrated to become effective. Dr. Fisher's theories, set forth in this article, are the latest and we believe the most plausible suggestion to be put forward.—THE EDITOR

NEW facts of technical interest to all engineers and builders, to say nothing of their appeal to the popular imagination, have been obtained by Dr. Clarence Stanley Fisher to help solve the mystery of how the ancient Egyptians built towering pyramids and huge palaces without the aid of modern lifting equipment. Dr. Fisher is the Egyptologist of the Museum of the University of Pennsylvania. He returned to this country recently after six years at the head of archaeological expeditions to the site of ancient Memphis, near Cairo, and to the royal cemeteries of Gizeh and Denderah.

Among the treasures of ancient craftsmanship brought back by the explorer or now on their way to this country are many ornate stone doorways, constructed of great blocks of stone, carved granite columns nineteen feet high, inlaid with an exquisite enamel or terra cotta known as faience, the floor stones from the dais of the Pharaoh Merneptah heretofore erroneously known as the ruler of the Exodus, and some huge carved blocks of alabaster.

The last furnish an excellent illustration of the perseverance and ingenuity of the ancients. Three thousand years before Christ, according to Dr. Fisher, they had opened and were working an alabaster quarry at El Amarna, eleven miles from the banks of the Nile and 200 miles above Memphis. To reach this quarry from the river bank it was necessary to build a road over many hills and through deep gullies and valleys.

"The road was constructed originally very much as our roads are built today," says Dr. Fisher. "The right of way was leveled and large stones were packed in. On top of these were placed layers of stones gradually diminishing in size, until the fine ground stone of the surface was placed. This was wetted and pounded, probably by hand, until the top presented a smooth surface.

"Blocks of alabaster weighing many tons were transported over this road on sleds, quite similar in all probability to the rocking-horse devices used for lifting purposes. Hundreds of slaves drew on the ropes attached to the sleds and the surface of the road was watered to make it slippery. The blocks were then placed on rafts and poled down the river, where they were transferred again to sleds and dragged to the building operation."

By far the greater part of the time spent by Dr. Fisher in Egypt was in the excavation of the Palace of Merneptah. This Pharaoh was the son of Rameses II. The Scriptures have several references to the latter as the king for whom the Israelites in captivity were forced to build a city, hence he had become known as the Pharaoh of the Oppression, and his son as the Pharaoh of the Exodus. Dr. Fisher has corrected this view by finding records showing that Merneptah made war on a tribe, palpably the Israelites, after they had settled in their Promised Land, and as they wandered forty years in the desert before this settlement it is obvious that Merneptah has been misplaced heretofore. Dr. Fisher believes, from other records, that Amenophis IV was the king who drove out the captives, about 130 years before Merneptah's time.

To date the Museum explorers have excavated one entire wing of the latter's palace. They found that this section was evidently the public building, and next year they plan to search for the private palace of the King and Queen. In the building uncovered was the throne room, surrounded by tall pillars supporting the roof. An outer wall beyond these pillars, made of sun-dried brick, was nine feet thick. When these bricks were torn down to obtain the doorways and window sections of carved stone, they were eagerly hauled away by the native farmers to be used as fertilizer, as they contained a large quantity of straw when made, about 3,500 years ago.

Herodotus records that the great pyramid at Gizeh took some forty years to build and required the labor of one hundred thousand workmen, says Dr. Fisher. While these figures may be exaggerated, the labor of constructing such an enormous mass of masonry must have been far greater than we usually conceive. The ancient Egyptians had no elaborate mechanical methods to assist them, only sledges, ropes and unlimited man power which they used in transporting and handling blocks of masonry, aided also by the inclined plane.

Stone was quarried by means of wooden wedges driven in at intervals along the cleavage line. Upon being soaked with water these wedges expanded and split off the stones. We find the same method used well down into Roman times and there are survivals even in modern days. Blocks were shaped and dressed with chisels and drills which were, so far as our evidence goes, of bronze.

The walls of smaller buildings, where the height was not excessive, were constructed by the use of temporary inclined planes of sun-dried bricks or rough rubble masonry erected against the outer face of the wall as the latter progressed. After the stones of the first course were dragged into position, this false structure was built to the height of the stonework already in place. Up these the blocks for the second course were dragged and placed in position, and so on up to the top. The final dressing of the face was begun at the top after the final course was in position, and the temporary structure was removed as this final dressing progressed downward.

In the interior of the building, where columns were used to support the roof, these, when they consisted of drums, were erected in the same way. When, however, they consisted of monoliths a different method was employed. This is very clearly shown in the temples of Kephren and Mycerinus at Gizeh. These were built in connection with the second and third pyramids of the group of which the famous great pyramid is the largest and oldest in date. Here, in the outer and inner halls, positions of the various piers were first marked out on the rock foundation. Then at each place a square shaft was cut with three sides vertical, the fourth side, always on the side from which the stones were to be brought, being cut away to a long slope. The roughly squared blocks for the pillars were then dragged on sledges until their ends were over the shafts and in line with the slope. The outer end of the block was then lifted up with wedges and ropes until it was standing vertically in the hole. The slope not only made this labor easier but made the stone rise into position without any serious jar, which might have fractured it. The shaft was then filled with stones and debris, over which the floor slabs of some finer material were laid.

In all temples the roofs as well as the walls and floors were of stone and these slabs were placed in position before the false work was taken down. All reliefs and other decorations on the walls were done after the masonry was fully in position. In the construction of the great pyramid similar methods were used. Here the whole structure was solid masonry, with the exception of the small burial chambers in the center with the passages leading to them. The burial chamber, which was sometimes below the actual level of the rock surface, was constructed first. In the pyramids

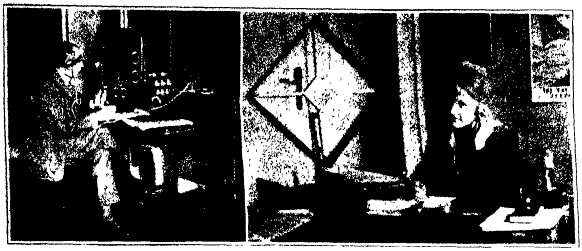
(*Continued on page 140*)

Making Radio Commonplace

GERMANY has been forging ahead in radio. Indeed, it is Germany's intention to make radio commonplace, and the work is already well under way. The Berliner can receive the news of the day, stock reports, shipping items and other important bits of information in his home or office at certain times of the day. Most important of all, these radio reports are in real understandable German, and not in the dots and dashes of the Morse telegraph code. They are sent out by special radio telephone stations operated by government and private enterprise alike and reaching all parts of the municipality

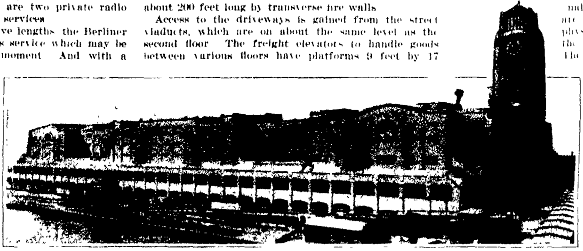
Today the German Post Office which controls telegraph and telephone lines, has five wireless telephone stations in operation A news service is also functioning between Berlin and other industrial centers For instance, Berlin and the Ruhr coal fields are kept in close touch with each other by means of wireless telephone service Then there are two private radio companies which operate news services

By tuning in for different wave lengths the Berliner can cut in on any desired news service which may be sending out reports at that moment And with a knowledge of the Morse code, the Berliner can copy messages emanating from the powerful radio telegraph stations of Germany and other European countries The apparatus installed in homes, factories and offices is made as simple as possible so as to give complete satisfaction in the hands of the average person Instead of a lofty antenna, a simple loop is employed Thus the entire installation can be mounted on an ordinary desk as pictured herewith —By *Alfred Longville*



At Left Telephoning the news of the day to the radio telephone news service subscribers *At Right* A fair Berliner receiving the radio telephone news by means of a loop receiving set mounted on her flat-top desk

Graphic proof of how Berlin is putting the radio telephone to practical use



Huge freight station recently completed in Chicago This building is five stories high and measures 745 by 420 feet in plan

A Giant Among Giant Freight Terminals

TO Chicago belongs the distinction of having the largest freight terminal in the world—the mammoth building recently completed for the Pennsylvania Railroad This freight house covers a whole city block, is five stories high and measures 745 feet by 420 feet in plan It not only offers every facility for the rapid handling of freight, but presents a most striking architectural appearance with its heavy buttresses, walls and arched openings and a massive tower 180 feet high at one end This tower contains a huge water tank and a clock with 16 foot dials

The building consists of a structural steel framework encased in concrete, making it fireproof, and with exterior walls of red brick trimmed with colored terra cotta. The ground floor is occupied entirely by tracks, nineteen in all, and trucking platforms. Fourteen of these tracks are in the main building, two each in the wings at the sides which provide covered driveways at the second floor level, and one outside the building at the east side. Between tracks the concrete platforms are 5 feet 4 inches wide. They have an average total length of 800 feet since they extend out from the south end of the building for a considerable distance. The track floor has a capacity of 875 cars a day.

The freight taken from or to be loaded into cars is assembled at the second floor level where driveways are provided at each side of the building, and two at about the center of the structure with a width of 72 feet These latter driveways divide the structure into the inbound houses 171 feet wide on one side, and the outbound freight house on the opposite side with a width of 100 feet This floor is divided into sections about 200 feet long by transverse fire walls

Access to the driveways is gained from the street viaducts, which are on about the same level as the second floor The freight elevators to handle goods between various floors have platforms 9 feet by 17 feet and are enclosed in fireproof shafts with 8 foot doors at ends Thirty one such elevators are in operation at the present time and provisions have been made for eighteen additional ones. Two large automobile elevators with 10 by 24 foot platforms are located near the south end of the building

This magnificent freight station is a part of the new Union Station plan now well under way, and which will involve an outlay of about $75,000,000 The freight station alone and as it now stands cost $4,000,000 - By *Robt H Moulton*

A Mighty Map

THE indisputable fact of being the largest relief map ever constructed alone challenges popular interest, but the supreme triumph of molding the world in miniature on a steel chart lends scientific emphasis to an achievement jointly shared by the U. S Shipping Board and the Navy Department The map of cast steel construction, recently completed, is 42 feet long and 15 feet wide, and weighs two tons, with a one-ton pedestal The immense profile was designed by H Lawson Guppy under the direction of the Shipping Board The uniqueness and magnitude of the product should serve to fulfil the purpose for which it was originally planned, namely, that of informing and concentrating public opinion of the necessity of upbuilding an American merchant marine

The structural features of the mighty map, as interesting as they are in their entirety by reason of the composite dimensions of the map and its steel formation offer additional interest when analyzed in details Land and sea are portrayed with respect to the physical and climatic conditions of the different zones of the universe The great waste areas of the Arctic circle as well as the shadowless waters of equatorial seas are denoted by pigments of varying hues Built in sections—twenty six all told—the enormous profile map is a veritable geography of the world, and school children who loathe the subject of geography as bound within the pages of a book would doubtless be fascinated with this description of the surface of the earth and its inhabitants wrought in steel The topography, verdure, climate of all lands are discernible while water-enveloped areas are painted in colors so as to identify the temperature, velocity, direction of ocean currents, as well as the course of trade and merchant marine routes

The actual construction of the steel chart embraced a series of steps The impressions were made from wax patterns which were cast in a sand flask filled with sand imported from the Catskill Mountains The modeling of the patterns was of such a character as to render it imperative to project the edges beyond their real limits, in order that relief work on adjoining panels should match when the facings were laid off The latter was machined to a fineness of one one hundredth of an inch

The boiler shop coöperated in producing an angle iron easel capable of supporting the twenty-six panels and when in a hanging position giving the realistic effects of a huge picture Six weeks were required to construct the map, which is composed of an aluminum of such fine consistency as to take the smallest impression This veritable geography of steel was first assigned for exhibition at the National Merchant Marine Week in Chicago, after which it will be detailed for a five year tour of the United States Its immediate mission of stimulating the claims for an enlarged merchant marine once completed, the product wrought in steel will have a permanent location in the Smithsonian Institution —By *S R Winters*

Officers of the U. S. Shipping Board and Navy Department inspecting the huge relief map made for the Smithsonian Institution

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

This receptacle under the theatre seat has a number of advantages over the usual wire loop

An Individual Check Room

A DEVICE, which can be attached to the underside of chairs in theaters and other public places, will hold parcels, wraps and hats, and serves the purpose of an individual check room The receptacle is made of wire and strong cloth and will support 75 pounds in weight The advantages of this attachment over the old single wire, which could be used only for a man's hat, may be at once appreciated, especially by the ladies Several theaters in New York have been equipped with this convenient and useful device

A Folding Boat for the Sportsman

OF folding boats, there is no end Just now Germany appears to be passing through an epidemic of folding boats, and we have the accompanying photograph to add to our published collection The boat shown is typical of the many excellent designs that have come to our attention, and certainly there is a genuine demand for such craft This boat may be folded together and carried in a handbag It has strong boardwalls which are provided with joints and folds between the light ribs The weight of the boat is 26 pounds The invention, in this instance also includes a collapsible mast and compact sail which may be used when desired

Copyright, Keystone View Co

A folding boat that can be carried in a handbag when completely folded

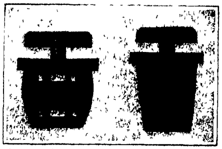
A New Stainless and Flame-Resisting Steel

A NEW steel of striking properties has recently been perfected by a large American steel company It is not only a new stainless steel, claimed as superior to the widely known regular stainless steel, but it is also non-magnetic and acid resisting But its most sticking and probably valuable commercial feature of quality is its flame resisting power When attached by the oxy-acetylene flame it requires 20 times as long to melt a hole through as to melt one through ordinary steels Because of this it is expected that an extensive use for it will be in vaults and safes to insure greater protection from safe-cracking and burglary

The new steel's composition is not yet made public but it has been developed as a result of a study of steels covering a period of a year or more, originally with a view of producing a steel that could be forged, rolled or sheared in thicknesses of 0.01 inch to 1 inch or more, that would offer maximum resistance to attacks by oxy-acetylene flame, that could be machined as well as capable of the drilling in it of holes

None of these aims has been realized It is non magnetic, rustless in water, fruit acids and glacial acetic acid which is a distinguishing quality as compared with other steels It is also untouched by 20 per cent or 10 per cent sulfuric acid, 32 per cent nitric acid and by 19 per cent by hydrochloric acid There is a probability that acid containers or carboys will be made of it successfully instead of glass as at present, insuring a safe shipping carrier and uncontaminated acids

An unusual property is that it has extraordinarily high reduction of area and elongation at temperatures which could burn anything but high speed steels.



Sectional and exterior views of the expanding stopper and how it functions

A Contracting and Expanding Stopper for Bottles

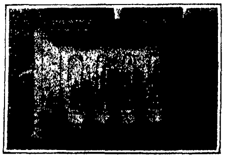
AN interesting device for hermetically sealing bottles after being opened is being marketed by a New York concern. This device is a stopper of pure rubber molded around a screw traveling within two washers, which are firmly embedded and keyed in the rubber The screw is swiveled in the lower washer to turn without engaging the thread As the screw is turned to the right the upper washer is brought closer to the lower one, thus expanding the rubber in between so as to enlarge the diameter. The reverse movement forces the washers apart, elongates the rubber, and positive contraction is provided. Thus it is possible to seal hermetically a bottle without the tendency of the stopper to adhere to the neck of the bottle. A twist of the handle to the left draws the walls of the stopper away from the bottle, permitting easy removal.

A Thread Holder that Saves Tangles and Temper

AN ingenious little novelty in the shape of a thread holder has found its way into shops for women. It is a patented mechanical device which holds a spool of thread so that it can be pinned to the sewer's blouse, always ready with a supply of thread to be pulled off It is light in weight, and the pin for fastening is small so that injury from constant pinning is prevented.

A Portable Light for the Photographer

A POWERFUL portable light and reflector for illuminating objects to be photographed has been developed by a New York commercial photographer As will be noted in the accompanying illustration, this new device consists of an open box-like arrangement, shaped like a large roasting pan, and containing a number of lamps. The box is lined with aluminum which acts as a reflector for four concentrated filament, 350-watt, nitrogen-filled lamps, which are wired to any standard lighting circuit. The device is provided with two handles, as shown, for holding it near the object to be photographed Furthermore, it is provided with a sliding cover which protects the lamps from breakage while being transported



A New York commercial photographer has developed this useful portable lamp

Hydrogen Alarm for Submarines

AFTER having discarded about a dozen instruments as unsuitable for detecting the presence of hydrogen in submarines, the Gas Chemistry Section of the United States Bureau of Standards has developed a new instrument which overcomes the objections of earlier designs The device, a description of which is being withheld from the public, has been given practical service at the New York Navy Yard and has been tentatively adopted for use by the Navy Department The severe requirements to which such an instrument is subjected in submarine service made the rôle of the inventor a peculiarly difficult one, and the design accepted necessarily sacrificed some of the advantages outstanding in its predecessors

An Indicator for the Electric Iron

AN indicator attachment for electric irons tells whether the electric current is on or off, a fact which cannot always be quickly told without some special means. The indicator works upon the solenoid principle, and the condition of the iron is easily told by looking at the small black indicating pointer which travels up if the current is on, and remains at the *off* point if current is off.

A thread holder which holds the spool pinned to the sewer's blouse

Recent Patent Decisions

The Measure of Diligence.—Appeal from a decision of an Assistant Commissioner of Patents in an interference proceeding awarding priority to senior party, Backdahl The invention relates to mandrels or cores for the formation and curing of pneumatic tires. Counts 1 3 and 6 are sufficiently illustrative of the six counts of the issue, and are here reproduced ·

1 A fluid-tight, hollow, stretchable, metallic mandrel

3 A tire-making mandrel, comprising a fluid tight, hollow, lead annulus, provided with an inlet for introducing an expanding fluid

6. A tire-making mandrel, comprising an inner rigid metallic ring adapted to fit between the halves of a tire mold, and an outer, annular, hollow, lead mandrel body thereon, provided with a fluid inlet pipe extending through said ring

The defendant is restricted to his filing date of December 4, 1915, for conception, disclosure and reduction to practice The Patent Office Tribunal found that the plaintiff conceived and disclosed the invention September 7, 1915 From that time to June, 1916, the plaintiff was endeavoring to evolve a fluid-tight and expansible lead core,

A glance at the indicator tells whether the current is on or off the electric iron

Device which is mounted on phonograph and serves to resharpen steel needles

adapted to produce a cord tire as well as a fabric tire. A core that would produce either would be within the issue. The application drawings were commenced the latter part of May and completed late in June, when they were turned over to a patent attorney who was very busy at the time and later took a vacation extending over a month There was further activity on the part of the plaintiff in August, 1916, and the application was filed on November 8th

It is held that where, as here, it clearly appears that the party first to conceive the invention was in good faith engaged in perfecting it at the time his adversary entered the field, that party should not be deprived of the fruits of his discovery because his efforts were not as successful as he hoped they would be, unless further tests were so unnecessary as to constitute evidence of negligence or bad faith

An inventor is to be commended rather than condemned for taking reasonable time to perfect his invention, to prevent the Patent Office from being overloaded with applications for patents for crude and incomplete devices

The court holds that Gammeter, the plaintiff, was not lacking in diligence. The evidence shows that he was diligent, and yet there is no arbitrary rule or standard by which diligence may be measured and each case must be considered and decided in the light of surrounding circumstances. The court is fully convinced of the good faith of Gammeter, the plaintiff, and therefore it reverses the decision of the Assistant Patent Commissioner, and awards priority to the plaintiff.—*Gammeter v Backdahl. U S C. C. A of D C.*

Copyright, Keystone View Co.

Shaped like the sole of a shoe, this entrance is bound to attract attention

A Tiny Grindstone for Repointing Steel Phonograph Needles

THAT highly fertile field for the inventive mind, the phonograph industry, has now introduced a new device in the form of a steel needle pointer This device, which is shown in the accompanying illustration, makes an ordinary needle play over one hundred times according to the claims of the inventor.

In brief, the new device consists of a stand which is mounted on the usual phonograph in such a way that its rubber-faced wheel may be brought into contact with the rim of the phonograph turntable. The device has a hole which takes the standard steel needle and holds it in such a way that the point comes in contact with a cylinder of abrasive material. Thus while the needle is being held in place, the abrasive face, revolving constantly, sharpens the point of the needle

A ruler on the under side of which are fastened nine blotters for the sake of convenience

A Ruler That Has a Blotter

SIMPLE, true, but highly useful is the device shown in the accompanying illustration. It consists of a ruler in the form of a strip of wood, on the under side of which are mounted nine sheets of blotting paper. This arrangement has evidently come from some inventive mind that has grown tired of searching for a blotter after using pen and ink. Essentially, the device is intended for blotting signatures, but it is a combination blotter and ruler as well

Making Toothbrush Bristles Removable

THERE is some doubt in the minds of certain authorities as to whether we have not been making a huge mistake in the use of a brush for the teeth They are advocating a soft cloth, and to this end one manufacturer has perfected individual paper napkins for the teeth The bone of contention seems to be in the fact that a toothbrush will and does collect bacteria, if not properly looked after To overcome this objection, however, a brush has been perfected which permits the entire removal of the bristle section It can be plunged into boiling water any time necessity demands Made entirely of metal, boiling will not injure either bristle section or the balance of the brush

An Entrance That Speaks for Itself

AN ingenious mind conceived the idea shown in the accompanying illustration Here is an entrance to a shoe-repairing shop, which has been cut out in the form of a shoe sole. Made of wall board, it is inexpensive and simple to construct, yet its advertising effect is well nigh incalculable, especially on New York's busy thoroughfare, lower Broadway, where thousands of passers-by can always be attracted by something out of the ordinary And the same ingenious mind has livened the "sole" entrance with several slogans, as shown.

A Reamer for the Hard-Worked Pipe

THERE has recently been perfected a simple device for cleaning the bowl of any pipe. This device, which is shown in the accompanying illustration, consists of a springy loop member on the legs of which scraper members are hinged To clean the bowl of a pipe, the scraper members are introduced and pushed down Automatically, these scraper members adjust themselves to the sides of the bowl, and the turning of the loop member or handle scrapes the bowl clean in a minimum of time and effort

Potash

WE had this subject very much before us during the war, and it was a poorly informed person indeed who could not make a show of intelligent discussion of the sources of potash, the costs of production, and the probabilities of the American industry becoming an adequate source of supply against the domestic demand, and of its resisting the efforts of Germany to make a post-war reconquest of this department of world economy But today we are very apt to forget that the problem exists or ever existed Mr Skerrett's discussion of it in the current issue of the SCIENTIFIC AMERICAN MONTHLY for February emphasizes the "picayune scale on which we have been searching for this indispensable raw material, and emits a timely word of warning against future repetition of the mistakes of the past

The Radio Typewriter

ONE of the recent developments in wireless telegraphy was demonstrated in Great Britain a couple of months ago This consists in the automatic printing of wireless messages in Roman type If it can be done over the wires, it can obviously be done without them, but the technique is of necessity somewhat different Those interested in the subject will find the apparatus described in the February number of the SCIENTIFIC AMERICAN MONTHLY The system makes use of a special perforator the tape from which is passed through a special typewriter and converted into readable messages

Removing the bristles from a recently-introduced toothbrush for a thorough cleansing

A New Rail Joint That Speeds Up Work

A SPECIAL rail joint devised to help speed up the work of moving rails ahead on a pipe-laying job in Denver has fully demonstrated its usefulness So much good time was taken up in assembling and disconnecting the regular splice bars, bolts and nuts that the need for a special joint was keenly felt The result has been that a joint has been planned that can be disconnected by a few blows of a sledge hammer A clamp a steel wedge and steel tapered pins are the essentials of the new arrangement One side of the clamp is so shaped as to fit firmly up against the side of the rail. The other side of the clamp, which stands several inches from the rail, is held by the tapered steel pins Under the pins and between the clamp and the rail is driven a steel wedge that tightens the joint Only three lengths of rails, which are spiked to 8- by 16-inch timbers, are used The pipe-layer keeps moving the rails ahead. This new joint was used successfully in laying a new concrete water supply conduit for Denver.

A push into the bowl of the pipe and a few turns scrapes the bowl

New Alloy for Watches

A DISCOVERY described as being capable of revolutionizing the watchmaking industry has just been announced by Mr G E Guillaume, Director of the International Bureau of Weights and Measures A successful method of regulation, remedying the variations in time of a watch due to the expansion and contraction of its parts caused by variations of temperature, is the result of Mr Guillaume's invention

This so called "secondary error" has always been one of the great obstacles in the attainment of perfection and precision in the watchmaking industry, and if this difficulty is overcome the watchmaking industry should receive considerable impetus, owing principally to the simplifying of the process of regulation The current issue of the SCIENTIFIC AMERICAN MONTHLY deals at length with this subject

The chief feature of Mr Guillaume's new process is a change in the alloy used in the compensating parts The minimum expansion of nickel steel was found to be increased by the addition of 12 per cent of chrome as well as a very small quantity of tungsten, manganese, or carbon By mounting a spiral of this steel-nickel-chrome alloy in the watch, according to Mr Guillaume's announcement, the problem of compensation has been solved and the secondary error' removed

Machining Material Glued with Casein Glue

CASEIN glue joints may be safely machined within four hours after gluing and before the glue becomes so hard as to injure the cutting edges of tools Three casein glues investigated at the U S Forest Products Laboratory all have a shearing strength of approximately 1,000 pounds per square inch within two hours after spreading and within four hours it reaches approximately 1,200 pounds The maximum strength of the joints and hardness of the glue are not reached, however, within the four hours

This new rail joint, intended for temporary track, may be disconnected by a few blows of a sledge hammer

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

MEANS FOR STABILIZING FLYING MACHINES.—S. De Santis, Naples, Italy. The invention relates to stabilizing wings of flying machines, having a pivotal connection between the wings and body, a weighted controlling lever at the center of gravity of the body, a plurality of guides and cables secured to the controlling lever, said cables passing around the guides then crossed and secured to the wings.

METHOD FOR PROPULSION OF SHIPS, BOATS AND FLYING MACHINES.—S. V Cortes, 268 Avenida del Brazil, Valparaiso, Chile. The invention relates to propulsion mechanism of the rotating blade or paddle wheel type, mounted on a vertical, horizontal or inclined shaft, at the sides, bottom, bow or stern of a vessel. The object is to obtain a greater efficiency of propulsion than has been attained with submerged paddle wheels and boxes, together with a lifting or sustaining effort which is especially useful when the system is mounted on submarine vessels, airships and airplanes.

METAL CONSTRUCTION.—E. E. Brown, and D. J. Mooney, c/o Steel Wing Co., Ltd., 48a Gillingham St., London, S. W., England. This invention relates more particularly to the construction of spars, an object being to provide a metal bar structure which combines strength with lightness of weight, and which is especially adapted for use as a spar in wings, fuselages, struts, and the like in the construction of airplanes.

Pertaining to Apparel

HOSE SUPPORTER.—C. J. Halsey, 368 W 50th St., New York, N. Y. The object of the invention is to provide a hose support of simple construction attached to a corset and arranged to securely grip the hose but insure perfect freedom to the wearer's body and limbs without producing undue strain on the hose. Another object is to permit the user to quickly engage or detach the support.

Electrical Devices

GEAR SHIFT.—O. D. Shepherd, 29 Abernarle Ave., Atlanta, Ga. The particular object of the invention is to provide an electrically operated gear shift in which the shifting in sequence or progression is automatic, but capable of alteration in the progression by manually operated control. A further object is to provide an electrically operated gear shift which will be to a large extent automatic, causing the gears to shift in the normal progression thereof, the initial operation being brought about by a manually operated clutch lever which closes the electric circuits.

GAS BATTERY.—P. A. Emanuel, Aiken, S. C. The foremost object of the invention is to provide a battery of the Grove type, the principal departure being that the platinum electrodes of the Grove cell are substituted by electrodes of a cheaper and different material. A further object is to provide a gas cell having a specially prepared iron anode and cathode suitably separated to segregate the dissimilar electrolytes in which the two electrodes are respectively immersed.

AUTOMATIC ELECTRIC FUEL MIXTURE REGULATOR.—A. A. Lorscher, 28 E. High St., Detroit, Mich. This invention has for its object to provide an automatic electric fuel mixture regulator for internal combustion engines, under the control of and responsive to the speed of the engine to effectively vary the proportion of the hydrocarbon and the air whereby the fuel mixture or charge delivered to the cylinders is accurately proportioned and of proper composition as to provide for perfect combustion and maximum power at all engine speeds.

Of Interest to Farmers

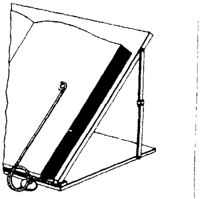
CHURN.—P. R. Thibault, Box 183, St. Ignace, Mich. This invention relates more particularly to a type of churn employing a stationary body and a rotating paddle, the body having double walls forming a liquid cooling chamber therebetween, the object being the provision of certain refinements as regards both the construction of the body and the paddle calculated to promote more ready manufacture and more efficient results.

HOE.—R. N. Moore, Box 23, Mitchell, Iowa. The invention more particularly relates to an attachment adapted to be applied to the standard makes of wheeled hoes. It is distinguished by an arrangement whereby one knife may be adjusted transversely and is rockable relatively to the other knife and independently of the guard, the guard is so formed that it constitutes a colter to cut hard ground in advance of the front knife, the guard has a relation to the rear knife to prevent plants from being damaged by the same.

SHOCKING ATTACHMENT FOR HARVESTERS.—J. C. Bader, Cando, N. D. The invention relates to machines for shocking wheat and other grain. One of the principal objects is to provide a shocking machine adapted to be attached to a harvester in place of the original bundle carrier, for receiving the bundles from the harvester, tying them together and forming the shock, and then depositing them on the ground butt end first, the machine moving away from the shock without disturbing the position of the latter.

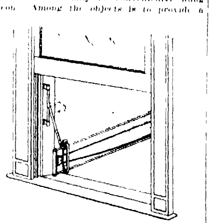
Of General Interest

BOOK REST.—H. W. Bromley, Wilmore, Ky. Among the objects of the invention is to provide a simple, efficient and inexpensive device for securing a book in open position against the rest, and to so construct the parts as to facilitate the removal of the book or the turning of the pages, the hands being free for making notes. The device permits of a comfortable position in reading, with a saving of eye strain, and an entire freedom of limbs, not possible when the book has to be held in the hands.



A VIEW IN SIDE ELEVATION

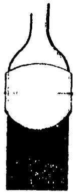
COMPENSATING SAFETY CLOTHESLINE HANGER.—A. Heyman and C. C. Vervoort, 152 Newell St., Brooklyn, N. Y. The invention relates particularly to a type of hanger which may be withdrawn within a window so that the clothes may be conveniently hung thereon. Among the objects is to provide a clothesline support of simple and rugged construction which is adapted to be positioned outside of the window when not in use, the support may be readily adjusted to windows of different sizes and is arranged to prevent the possibility of collapsing when in use.



VIEW SHOWING THE APPLICATION OF HANGER TO A WINDOW

FLYTRAP.—I. J. McKay, P. O. Box 1522, Atlanta, Ga. The invention has reference to a fly trap that is of a most sanitary nature. Among the objects is to provide a device having a body or main receptacle of such material as to be easily and thoroughly sterilized and from which practically all of the parts are removable. Another object is to provide a trap that is so constructed as to provide for the utmost attraction for luring the insects thereto.

BRUSH.—J. Bergsten, 1324 Edwards Ave., Bronx, New York. The object of the invention is to provide a brush arranged to permit of readily and quickly assembling the parts and to allow of conveniently replacing a worn brush body by a new one. Another object is to form a brush body of an inexpensive material by using the heretofore wasted bark of the balsa (Ochroma lagopus).



A PLAN VIEW OF THE BRUSH

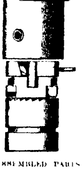
ICE CREAM CUTTER.—I. Seitzman, 774 New Jersey Ave., Brooklyn, N. Y. An object of the invention is to provide means for simultaneously cutting a large number of bricks into pieces of uniform or any desired size. A further object is to provide a machine which may be operated by hand power, foot power or engine power, such machine including the construction of a tray on which the bricks are supported and cut.

MANUFACTURE OF SHOES.—H. W. Siedler, Lossnitz, Erzgebirge, Germany. The invention relates to a method of making shoes having a previously formed tip, an insole, and an upper comprising an abutment member on the outer edge of the upper, positioning the upper by pressing said abutment member inwardly over the bottom of the insole, securing the upper and insole together, and removing the abutment.

BAG.—J. Stember, 36 E. 22nd St., New York, N. Y. The object of the invention is to provide a hand bag, traveling bag or like article having a metallic frame whereby a secret pocket for containing bills or valuable papers is provided to prevent unauthorized persons gaining access to such secret pocket while the bag is in the possession of the owner.

Hardware and Tools

ATTACHMENT FOR PNEUMATIC TOOLS.—A. E. Moore, 377 Quincy St., Brooklyn, N. Y. An object of the invention is to produce an attachment for use in connection with air driven hammers or other pneumatic tools used in connection with all manners of steel structure work, for driving rivets and executing other work necessitating a hammering tool, or which may be used for rotating drills, reamers and similar machine tools.



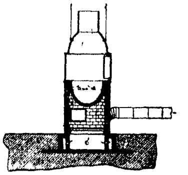
THE TOOL DISASSEMBLED PARTS DISPLAYED AS REMOVED FROM SLEEVE CASING

KITCHEN KNIFE.—R. L. Moffett, 4618 N. Racine Ave., Chicago, Ill. An object of the invention is to provide a kitchen knife with means for holding an ordinary safety razor blade firmly in such a position that one edge of the blade serves as a cutting edge for fruit, vegetables and the like, while the other edge is sheathed to insure the back edge of the device being blunt.

TIRE CHAIN TOOL.—S. G. Doolittle, 7 Burnes St., New Haven, Conn. The invention has particular reference to a hand operated tool for opening and closing the hooks of chains commonly used for non-skid purposes on automobile wheels. Among the objects is to provide peculiarly shaped jaw members so designed as to reduce to a minimum the likelihood of slipping of the tool in the opening of a chain link.

Heating and Lighting

SOFT METAL FURNACE.—J. B. McClain, 803 Fourth Ave., Brooklyn, N. Y. The invention especially relates to furnaces for melting certain ores or metals that are not overly refractory. Among the objects is to provide a furnace having peculiar merit for the melting of aluminum, babbitt metal, solder or other soft metals, the flames and other products of combustion being caused to pass through or over the bowl. In this device the operator has access to the metal, and means are provided for pouring the molten metal directly from the bottom of the bowl.



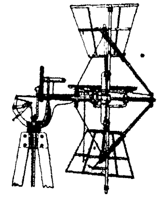
A VERTICAL SECTION OF THE FURNACE

STEAM BOILER.—W. F. Schanzlin, 282 S. Jameson Ave., Lima, O. The primary object of the invention is to construct a water tube boiler in such manner that the water tubes are subjected to the greatest possible amount of heat. A further object is to construct the water tubes in such manner that the cross over tubes are entirely eliminated, thus doing away with dead air space, and consequent loss of heat. A still further object is to provide a plurality of upper drums and means for securing them together.

Machines and Mechanical Devices

STAMPING MACHINE.—J. L. Jacobs, 824 Lafayette St., New York, N. Y. The invention relates more particularly to the stamping of ribbons, and its object is to provide a machine by means of which gold (liquid or ink) may be used in applying marks to ribbons, and which will reproduce the mark in a clear cut impression, which may be subjected to extremely rough usage without detrimental effects.

WINDMILL.—O. Olsson, Ord, Neb. An object of the invention is to provide means for constructing and connecting the blades or vanes of a windmill with the operating mechanism. A further object is to provide means for preventing the windmill from becoming forced out of operation by a sudden blast of air. The windmill is so mounted as to obviate the necessity for a regulating vane, and is entirely automatic in its action.



A VIEW IN SIDE ELEVATION WITH CERTAIN BLADES REMOVED FOR CLEARNESS

(Continued on page 138)

A Giant Job of Underpinning

(Continued from page 124)

In places where derrick stone was used there was no attempt to insert mortar of any kind.

The building was put up at a cost of $24,000,000 and required twenty years to build. Only the fact of its slow growth prevented its serious settlement and cracking, according to present day engineering opinion. Its tremendous weight was applied so slowly and so uniformly to the inadequate foundations that there was time to accommodate them to the load. On one corner—the northeast—the foundations rested on solid rock. But this rock surface shelves away toward the northwest corner and the entire south side of the building Above it is a layer of disintegrated mica schist, and above that a hard packed gravel and sand formation capable of supporting considerable weight.

Here was a problem almost without precedent in a building of this size It was obvious that if work progressed along the lines originally planned, to expose the foundations, they would crumble into dust and there would be serious and perhaps dangerous settlement There was nothing to do but to abandon the initial plans and set about making new ones. These had to provide not only for complete replacement of the defective rubble walls by brick or concrete masonry, but also an entirely new method of roof construction for the subway station The first plan of roof construction called for a roof of steel transverse girders carried by steel longitudinal girders between the subway tracks, these in turn resting on cylindrical piers sunk as open wells It was considered that because of the initial disturbance necessary to the foundations, such a roof would be inadequate and its use might be followed by destructive settlements

Early in 1916 the Department of Transit approved the new plan and operation was started. The entire roof of the subway was built on the ground surface, through or adjoining the foundations, and simultaneously with or immediately following the reconstruction of the old foundations The support of the building on the soil was temporarily increased by the placing of reinforced concrete or steel roof girders along the sides of and as part of the new foundations, in order to carry their load between the intertrack subway walls to be built later The subway roof, consisting of a close assembling of girders, thus formed the lowest course of the building, but did not take any of the weight at this time, as will be seen

The operations of rebuilding foundation walls and building the subway roof and walls are more easily described separately, although the work was necessarily interdependent. For the foundation work, pits were sunk on both sides of the wall at each point of attack, six feet long in the direction of the wall and four feet wide. In the solid masonry or brick work above the rubble foundations, narrow slots were cut. The pits were sunk to a point nineteen inches below the level of the subway roof, and then their floors were planked with a heavy mattress On these mattresses were placed jacking drums, four to a pit Two pairs of fifteen-inch I-beams were then inserted as needles through the slots in the masonry above, their ends bearing on the drums Each of these four drums contained a hundred-ton hydraulic jack, and by means of these half the estimated load of the six-foot section of foundation was taken up.

The next step was to remove the wall between the pits. The plank mattress was then extended to close the aperture, and on top of it was laid a grill of 15-inch I-beams. Four other posts were placed on this grillage and wedged against the needle beams, and the hydraulic jacks were removed. The beam grill was then concreted, forming the base for new foundation walls Thus two partial shifts of weight had been accomplished, one to temporary foundations on undisturbed earth, the second to the new foundations Eventually the entire weight went to these new foundations

The entire 700-foot length of the subway section was reconstructed in these short six-foot sections As a rule, men worked in gangs of five Many sections were rebuilt simultaneously, but they were so widely scattered that there was never any possibility of more than local disturbance to the weight When, by this means the length of an entire roof girder section had been completed, the concrete or steel beams were placed parallel to the wall When the foundations of the entire wall had been reconstructed one fourth of the area and tonnage of the building rested on the roof of the subway, which in turn rested on the solid, undisturbed earth

The operation of underpinning the roof, with its weight of one hundred thousand tons was a marvelous demonstration of the accuracy of modern engineering methods Sheeted pits were dug under the ends of the completed roof girders, one by one, and widely separated, as in the case of the temporary pits for the foundations To reach the points where these pits were to begin, pits were first dug in the City Hall basement, and tunnels were run in under the girder ends It was possible to use gangs here of but four men, who sheeted and dug out the pits, which range from four by five to five by eight feet The dirt was lifted in pails and small sheet iron barrels on a chain block supported on a beam over the top of the pit, and wheeled through the tunnel to the basement floor As a rule these pits were sunk to an average of seven feet below the groundwater point, but some of them went down to ten or twelve feet This bottom level is five to eighteen feet above the rock

Fifteen inch steel-pipe piles were now driven down the pits to the rock Muck was removed from the pipe every four or five feet by filling three or four feet of water into it, sinking a three-inch air pipe with 100 pounds pressure and turning on the blast When the pipe struck rock bottom it was filled with concrete The smaller pits contained four such pipe piles, and the larger ones as many as fifteen When they had been driven the pits were filled with concrete and grouted or bricked up under the roof girders These concrete pits, built separately and at widely distant points, form the walls of the subway Yet when all had been built and the core of earth had been removed, the piers were in perfect alinement

The removal of the core meant the second complete shift of the weight Up to this time it had been on the foundations of which the roof girders are a part, but these rested on solid earth and the piers had not taken the load. This was the final test of the whole long tedious operation As the work progressed in sinking piers, every possible precaution was taken Thousands of tests were made of the bearing power of separate piers, by hydraulic testing apparatus. Engineers were employed who did nothing but examine the walls of City Hall minutely, day by day Every crack was marked so that at the slightest sign of spreading it might be discovered

Excavation was started at the south end and carried through in three operations The first lift was just enough for a shallow heading, high enough to give working room to remove the temporary grills, which had been separated from the roof girders and foundations above by a tar-paper joint But in order to bring down this grill it was necessary in some instances to use air hammers or light charges of dynamite With this down, excavation was resumed down to the ground water level A third lift took out all the earth in the core down to sub-

At more than twenty-two thousand garages, in town and country, empty Prest-O-Lite Gas Tanks may be exchanged for full ones

Our complete line of appliances using only Prest-O-Lite Gas and air suitable for soldering, brazing, paint burning, etc., is extensively used by manufacturers and in repair shops everywhere.

Light for your truck

Prest-O-Lite

The Gas of a Thousand Uses

IT'S ECONOMICAL

THE initial cost of installing Prest O Lite Gas equipment is small Any man who can handle a wrench can do the job in a few minutes and once a Prest O Lite outfit is in place it will outlast the sturdiest truck Our exchange system makes the cost of operation extremely low

IT'S DEPENDABLE

Prest O-Lite Gas light never deteriorates — never "peters out" The last foot of gas in a Prest O Lite Tank gives the same dependable light as the first foot Rough going cannot affect the intensity and range of Prest O Lite — there is nothing to work loose, wear or break *Prest O Lite Gas is the most dependable of all truck lighting systems*

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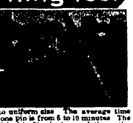

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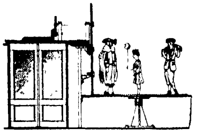
RECENTLY PATENTED INVENTIONS

(*Continued from page 136*)

DISPLAY DEVICE.—J D NOBLE, c/o J Evans, 705 Carroll St, Brooklyn, N. Y. An object of the invention is to construct a display device which will act as an attractive advertising medium The invention aims to provide a regulator particularly applicable for use in connection with revolving doors which will prevent of a too rapid rotation of the door and at the same time permit a utilizing of the energy now wasted in a door of this type



A PARTLY SECTIONAL FRONT VIEW OF A FORM OF THE DEVICE

Medical Devices

BEDPAN.—K E BLUM, 220 Broadway, New York, N Y This invention relates to hospital appliances It is one of the primary objects to produce a device of this character which is capable of being readily taken apart in order that the contents may be conveniently emptied, and the pan properly cleaned and kept in a sanitary condition

Musical Devices

PEDAL OPERATED DRUM BEATER AND CYMBAL-SOUNDER.—R C SCHEURER and H A LATHROP, 508 Summit Ave, West Hoboken N J The invention relates to pedal-operated devices for beating a bass drum and sounding cymbals in an orchestra, the device may be readily attached and detached and securely adjusted being pedal operated, it leaves the hands free to beat the small drum or play other instruments

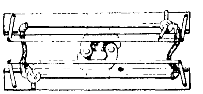
Prime Movers and Their Accessories

APPARATUS FOR RECLAIMING OIL.—J R MILLER, 4026 N Minister St, Pittsburgh Pa The object of this invention is to provide an apparatus by means of which lubricating oil, such as oil drained from the crank cases of internal combustion engines, may be reclaimed and made fit for use. A further object is to provide an apparatus for coagulating the dirt, driving off the volatile hydro carbons with which the oil is contaminated, and preventing the formation of emulsions during the process

STARTING DEVICE FOR EXPLOSIVE ENGINES.—A WEISS, 405 E 82nd St, New York, N Y The invention aims to provide a crank by means of which the crankshaft of an engine may be turned over at will but should the engine back fire resulting in a reversal in the direction of rotation of the crankshaft the crank will be thrown automatically out of engagement with the shaft and consequently no injury could result to the person operating the same

Railways and Their Accessories

TRAIN LINE CONNECTION.—A LAF BARRINGER Statesville N C The invention has for its object to provide mechanism in connection with the train line of an air brake system, for permitting the lines on cars to be connected at either side of the cars without the necessity for entering between the cars and for providing a double connection, either of which may be used, the connection being shiftable from the car or from the side of the car



SHOWING A TOP PLAN VIEW

AUTOMATIC TRAIN STOP.—F T CHALONER, 510 W 47th St New York, N Y The invention relates particularly to train stops adapted to be attached to a locomotive or other part of the train and arranged to engage and actuate danger arms positioned along the track whereby the stop mechanism will be operated for opening the air brake system of the train when the danger arm has been engaged.

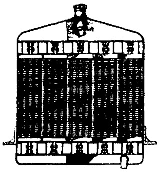
RAILWAY TIE AND FASTENER.—H A CLARK, Box 1257, Detroit, Mich A purpose of the invention is to provide a railway tie comprising a pair of plastic blocks spaced apart and formed with sockets, in opposite ends thereof, and fasteners of simple and durable construction which effectively support the rails and their loads, securely hold the rails against spreading, and withstand the action of the elements.

Pertaining to Vehicles

DECK COVERING FOR VEHICLES.—M PETTER, 9 W Chamberlain St, Chattanooga, Tenn The invention relates generally to vehicle tops and more particularly to a deck or covering for commercial and pleasure vehicles, the object being the provision of a deck structure which will be rigid, strong and light in weight with permanent waterproof qualities

POWER PLANT FOR VEHICLES.—P C LEIDICH, 4236 Paul St, Frankfort, Philadelphia, Pa The invention relates to power plants especially adapted for, but not necessarily limited to use in connection with automobiles, the general object is to provide a power unit in which compressed air is employed as the motive fluid, the unit being so designed that the storage tank can be charged from an external source or from one or more pumps installed on the automobile

RADIATOR.—L LOUGHLIN, 112 Jefferson Ave, Jersey City, N J The invention relates to radiators for motor vehicles The primary object is to provide a radiator which comprises a plurality of individual sections, any one of which may be removed for the purpose of repair without rendering the radiator wholly inoperative



A VERTICAL SECTIONAL VIEW OF A RADIATOR AS INVENTED

THAWING MEANS FOR RADIATORS.—B M COBB 711 W 180th St, New York, N Y The object of the invention is to provide thawing means arranged to permit of quickly thawing out a frozen radiator on starting the internal combustion engine of an automobile, airplane or the like Another object is to provide a device which can be readily applied to various makes of radiators without undue alteration in the construction, or in the operating of the engine The device can be readily attached or detached

TRANSMISSION MECHANISM FOR AUTOMOBILE VEHICLES HAVING WHEELS AND ENDLESS TRUCKS.—E RIMAILHO 12 Rue de la Rochefoucauld, Paris, France This invention has for its object a transmission mechanism which permits of obtaining in an automobile vehicle an alteration from the progression by wheels to the progression by endless tracks or vice versa This device is particularly intended for use where it is necessary sometimes to travel by road or across fields and over rough ground

Designs

DESIGN FOR A DOLL.—E EY, 158 Fifth Ave, Woodside, L I, N Y

DESIGN FOR AN EMBLEM, BROOCH, BUTTON, FOB OR SIMILAR ARTICLE.—J B CURRAN, JR, 2433 Valentine Ave, Bronx, New York

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grade. All that remained to be done of the major operation was to build the six-inch sub-base and the 12-inch top floor.

Throughout the entire acre of masonry shifted in this feat of engineering, but one crack was found, and that was found to be a purely local disturbance that might have happened anyhow. Yet this crack calls attention to one of the most remarkable features of the work City Hall is equipped with four corner towers, each of which contains a circular stairway from the street floor to the sixth These are considered more or less of an engineering marvel Each stairway consists of huge blocks of granite, one end of each cut at a sharp angle and cantilevered into the masonry wall There is no other support than the angle and, of course, the rigidity imparted by the structure as a whole The crack was in the wall supporting one of these blocks It was in the two circular stairways included in the underpinning, that trouble was expected.

To avoid it variations of the plan described were used under these towers, and under the south branch of the Market Street Subway The masonry under the south tower was in fairly good condition A steel plate girder was laid in a trench parallel to the foundation, virtually at its base, and at the ceiling level of the subway A concrete buttress to the wall, bonded into the old masonry, was then cast above and around this girder This increased the area of foundation on the ground, compensating for a drift then cut through the wall behind the girder and buttress A second girder was put through this drift and brought to bear on a mattress of concrete on the soil below When the entire set of transverse girders had been placed by this method, drifts were cut under their ends for longitudinal girders on the line of the future subway walls Pits for the wall piers were then sunk one by one under these longitudinal girders, and concreted. A variation of this method was used on the other tower.

For the Market Street Subway undercut it was necessary to reconstruct the concrete floor of this old subway in order to make of it a bridge to cross the new subway Drifts were cut through on the line of the new subway walls, six feet high, and timbered as they proceeded When completed they were concreted solidly between side forms, thus forming a deep concrete girder under the old floor The new steel construction was then put in place one track at a time, by night work, when traffic was light or could be diverted to a single track Then piers were built as in the other operations under the main girders

What added to the difficulty of the entire operation was the fact that the subway section consisted almost exclusively of a station, and not straight tunnel work. There are three inner and two outer walls to the construction, and eight entrance and exit passages Some of these are from the interior courtyard of the City Hall, and some from the outer plaza During the early months of the operation a flurry of local interest was caused by the supposed discovery of a hot well under City Hall Engineers found the ground water unusually warm, and once in a while steam was emitted. Various tests were made to determine whence this came, but unsuccessfully Aniline dyes were placed in the sumps of large office buildings nearby, but were not traced to the warm water.

It is estimated that it will be five years before this station is in use, although there is little to be done to it now but to lay tiles and tracks. The final system will include a delivery loop running east and west from Broad Street on Arch, one block north of City Hall, south on Eighth and Sixteenth Streets (Broad is the equivalent of Fourteenth in the numerical order) and connecting on Locust, two and a half blocks south of the hall. Two sections totaling about a thousand feet have been constructed of the subway on Arch and Locust Streets.

When originally planned it was estimated that the system would cost $56,000,000. That sum, of course, is now far from adequate. One estimate places it at $100,000,000 and others still higher. This is for the entire system, including two elevated lines connecting with the northern end of the subway, and the Frankford elevated, connecting with the Market Street elevated at Front Street and running into the northeastern section of the city. This latter line is complete except for some station work and equipment

The subway work, particularly around City Hall, was accomplished with remarkably little disturbance to foot traffic and almost none to vehicles. An occasional derrick rising between green-painted board fences gave little idea of the intricate operation going on underneath On the surface the dynamiting in the final stages was little more than a dull rumble This had to be used with the utmost delicacy and accuracy. In some places there were huge blocks of concrete that had been laid as temporary foundations, within the earth core, and these were broken up with the explosive.

Why Balloons Bounce Off Clouds

(*Continued from page 125*)

fined to balloons, and that is not felt by the pilot of a plane

The cloud obstacle which confronts lighter-than-air craft has an exactly *opposite effect upon* machines that are heavier than air The effect, however, is much less noticeable in the latter. When an airplane encounters the cool air of the clouds, there is an increase in the lifting efficiency of the wings because of the greater density of the cool and damp air Also, when an airplane emerges above a cloud into the warm layer of air where the density is less there is a tendency for the craft to sink, but this is usually counteracted by speed. Many airplanes can climb at a fairly steep angle with a speed of sixty miles per hour Whenever a heavier-than-air craft starts downward from above the clouds, and strikes the warm layer of air it would likewise sink readily and easily through, which is exactly opposite the effect created by this warm air upon balloons.

The Vacuum Tube as an Engineering Problem

(*Continued from page 125*)

In the case of the tube, he does not usually know the indications of trouble and the various limits for the tube, simply because as yet the tube is a comparatively new device

The user of a kilowatt rotary converter knows that he can probably get 2 kilowatts out of the machine for a short time, but he also knows that certain things are sure to happen if he persists in doing it continuously The fact that he can get 2 kilowatts from his machine does not induce him or the manufacturer to rate it at 2 kilowatts because they both know its limitations.

It is the same with a vacuum tube. The maker may give it a rating of 50 watts and it may have been carefully tested so that it is known that under the specified conditions it will deliver that energy continuously through a life of so many hours. If, however, when using it in the regular way, the filament and plate voltage are both raised, it may be possible to obtain 100 watts. Yet it is not right to call this a 100-watt tube, because in so raising its output some factor, usually the life, will be unduly affected.

As another example, take the case of an abnormally large input for a normal output, mentioned in the case of the rotary converter. Such a condition is common in the operation of a power tube and will have bad results if not corrected. When, in the future, knowledge

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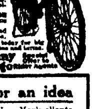

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relative to the vacuum tube is greater and more widely distributed, the condition described above will be understood when it appears and the cause remedied to the same extent as in a rotary converter

It will be seen, therefore, that improvements in the performance of tubes and vacuum tube apparatus is dependent upon three factors, which, at the *present time*, probably are of the following order of importance:

(1) Engineering development of fundamentals which have already been discovered or worked out by scientists or physicists

(2) Better understanding by the users relative to the limitations and possibilities and the engineering principles involved

(3) Discovery of new scientific facts

As the art develops the third factor becomes increasingly important and undoubtedly will sooner or later head the list.

Pumping Coal from Mine to Seaboard

(*Continued from page 126*)

machine, which separates the impurities

The coal which is reduced to a pulverized consistency is then shot into the pipe line and carried to the cities by means of the power from pumps placed every few miles The process of mixing pulverized coal with water and pumping the mixture through pipes was invented by Wallace C Andrews in 1883 and patented by him in 1891 He built experimental pipe lines to demonstrate the practicability of the scheme It has already been demonstrated that mixtures of 50 *per cent by weight of coal* and water can be successfully pumped, and not only that, but the mixture may be allowed to stand in the pipes for more than 24 hours and pumping be resumed without trouble The assertion is made that mixtures of 75 per cent by weight of coal and 25 per cent of water can be successfully pumped, and it will probably be found that mixtures with even higher percentage of coal can be sent through the pipe line

On the first page of this issue is shown a set of diagrams of the apparatus of Mr Bolton's system It has already been demonstrated in Germany and Great Britain, and in this *country that the most* economical way to burn coal is as a powder, as witness the immense blowers and automatic stokers which use this kind of coal in all of our great cities In such conditions it is easily handled and is under perfect control, and practically no smoke results Blown into the highly heated combustion chamber, each particle of coal explodes and becomes a gas The coal in this condition makes the next best fuel to natural gas The induction of it under the proper air current is automatic, causing a great saving of labor The burning value of the coal is enhanced about twenty per cent The present wasteful methods are soon to be replaced by this method of pulverizing coal and the resulting saving and cheap price of coal to the consumer will do away with the fear of car shortages and other things which have heretofore held back the supply when most needed.

How We Think

(*Continued from page 128*)

ment, the neurone fibers develop a protecting sheath. The precise function of this structure has still to be demonstrated. It is believed that it may aid the transmission of nervous impulse along the fiber

Observations show that while the other layers of the cortex early reach their complete development, the pyramidal layers continue to increase in thickness until later in life, and do so at a very slow rate. This may possibly be in order to accommodate the growth of the pyramidal neurones These continue to develop throughout the life of the individual, as experience with the environment stimulates them to perfect their interconnections Hence, we may say, that here, as in the case of the animals lower than man it is the number and condition of growth of the pyramidal neurones which determines the status of mental capability

Further light upon the relations of the *pyramidal neurones to* intelligence has been shed by the study of the brains of the idiotic, imbecile, and feeble minded It has been shown that the pyramidal neurones of idiots are poorly formed, undersized, and, more important still, possess very few fibers In extreme cases no fibers at all were present This means that correlations, connections unions assemblages of ideas, memories, sensations, etc, are impossible where there exist no physical connections between the multitudinous pyramidal neurones

In conclusion it might be said that it is this inability of feeble-minded parents to transmit to their offspring anything but imperfect intellectual equipment, which in no slight measure is menacing many of our urban communities, as well as filling our asylums and jails with the criminally insane to be harbored at state expense The *fact* that the *number* of pyramidal neurones is fixed before birth has an immense sociological significance, a significance, which, as has been said, is often a tragic one!

The Six-Wheel Truck with Four-Wheel Drive

(*Continued from page 129*)

meshed properly motion is transmitted to the shaft and through the gears to the two differentials so that both pairs of drive wheels will have uniform speed The ground friction of the vehicle is thus greatly increased, with a corresponding rise in the carrying capacity Importance is attached to the means for connecting the two axles of the attachment, for the reason that this is of such nature as to hold them firm against all relative motion save in the vertical plane

Truck users find that this outfit will go wherever a team will go and no ground seems too soft or too uneven for it to negotiate One of the demonstration stunts was the crossing of heavy marsh land while *loaded with a miscellaneous* assortment of farm tools, wire, fence posts, etc Even ditches at which the ordinary truck balked were crossed without apparent extra effort

The manufacturers insist that this is the only four-wheel drive, six wheel truck that has been successful It is inexpensive and will be of special value to farmers, since it is particularly adapted to the hauling of milk, cheese, feed, livestock, and in general to any use where mixed heavy and light hauling is required of a single installation

Leading Navies Compared

(*Continued from page 130*)

32, and Japan 11 If the present shipbuilding programs are carried out, by the year 1924 the United States will possess 33 capital ships, Great Britain 32, and Japan 17

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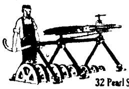

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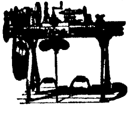

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nese fleet, as is shown by our comparative diagram

There is another consideration, however, which should modify any estimate of the comparative power of our own and the British fleet in 1924, and, to a certain extent, today—and this is that, while the British capital ships with the exception of the "Hood," do not embody the extremely valuable lessons which they learned from the Battle of Jutland, our own ships will embody this knowledge The "Hood" was built subsequently to the Battle of Jutland, and she is considered by the British to be greatly superior in offensive and defensive qualities, even ton for even ton, to any of the existing capital ships of her fleet The Jutland lessons as regards hull protection, et cetera, were only applied in a patchwork way to a few of the existing British battleships and cruisers for the first line, but all of the priceless information gained from that battle was given freely by the British Admiralty to our own Navy Department which has been free to embody it in our later ships, and most of it undoubtedly, has been and will be so used Consequently, in addition to the great preponderance of displacement and gunpower which our new Navy will show, as disclosed on our diagrams, there is a hidden but valuable preponderance of quality due to the incorporation of the rich experience of the war If Great Britain builds no ships during the next four years, her navy at that date though large in numbers, will be, all of it, more or less obsolescent and many of its earlier battleships will be absolutely obsolete

It is impossible at the present time to make any predictions as to the future composition of the leading navies and their relative strength In Great Britain and, to some extent, in this country, there is a violent controversy raging as to the value of capital ships To those of us who are informed and keep in close touch with naval affairs, this controversy has no such great significance as it must seem to have to the average lay mind Indeed, with the exception of one or two of the older admirals, Lord Fisher and Admiral Sir Percy Scott, who had no active sea duty during the war, the bulk of the attack which is being made upon the battleship in favor of the sea plane and the submarine has been carried on by people outside of the navy, or by men inside and outside the navy who are interested in advancing the cause of the submarine and the seaplane and airship To our mind nothing has been brought forward which has shaken the position of the capital ship as the foundation of the fighting line of a nation's forces

Where Our Fleet Is Deficient

We have many times pointed out in these columns that due to the interference of Congress with the plans of the General Board for building up our sea forces, our navy is today, and always has been, poorly balanced Our navy has always been distinguished for an excess of battleships in comparison with the other types of fighting vessels which are necessary to make up a well rounded fleet Today we are over strong in battleships and destroyers and we are weak in battle-cruisers, scouts or "light cruisers" as they are now called, large sea-going cruisers, and flotilla leaders Our lack of any battle-cruisers in commission today is, of course, the most serious problem of all Should we find ourselves at war with a navy possessing ships of this type we should be powerless to maintain our lines of communication with the fighting fleet, or to prevent a wholesale and most disastrous raiding of our mercantile fleet If the Germans had possessed the true sea-going and sea-fighting spirit, they would have sent their battle-cruisers out onto the seven seas, where they could have remained away from their base for many months, preying upon commerce and replenishing their fuel and stores from captured ships. The allies would have had their own battle-cruisers with which to hunt for these raiders; but since they were of about equal speed, it would have been a long and doubtful chase. In our case, with no battle-cruisers whatsoever, we were without any ship during the war that was able to overtake and engage these powerful vessels with any prospect of success

We are building ten scouts that will be the fastest and most powerful of their type when they are in commission, but we need more of these Also, it was proved during the war that for the proper handling of destroyer flotillas, each should have a larger vessel of its own type to act as a flagship At present we have none of these

Udoubtedly, at present, the citizens of every nation are in favor of a drastic reduction of naval and military expenditures This is certainly true of two leading nations, Great Britain and the United States, and some of the leading officials of Japan have expressed themselves as also in favor of a great reduction In view of this spirit, which is certain to bear some fruit we suggest that what money is voted for construction should be devoted to filling in the gaps in our navy. We suggest that we should cease for the present the construction of the six big battleships of the "Indiana" type and devote our efforts to completing the battle-cruisers and scouts and building a certain number of flotilla leaders. Lastly, in view of the great importance of aerial observation, we should commence the construction of two large airplane carriers of at least 80 knots' speed. If appropriations for new construction will not cover this, we suggest that it would be a good policy to redesign two of our battle-cruisers as airplane carriers and complete the other four according to the present designs.

The Engineers of Ancient Egypt

(*Continued from page 132*)

of the IVth dynasty this chamber was lined and roofed with fine masonry, and in order that this could be built a great square pit had first to be cut down to the proposed floor level of the chamber, and in this the complete room was built. The pit was then filled in around and above the walls and roof of the chamber with rough masonry The passages were begun in the same way, and as they sloped upward through the masonry of the upper structure work on them was continued *pari passu* with the building of the pyramid As pyramids had a height of from 200 to 500 feet the incline used for dragging up the blocks was built around the sides of the pyramid itself, spirally, as we might say. It has been suggested by a St Louis architect that this slope was actually left in the masonry itself and later filled in after the main mass was completed Since the pyramids were all faced finally with finer stone, it appears that this casing was placed in position from the apex of the structure downward, and that as it was completed, it concealed the incline and a smoothly finished, sloping face was left behind as the masons worked their way down

Still another method of lifting described by Dr Fisher and long known to Egyptologists is the rocker device One end of this, as shown in the illustration, was tilted down By means of wedges and levers the block of stone to be lifted was transferred to this end. Levers were then inserted in the other end, which was pressed down by man power until the stone had been lifted as high as possible, when that end was blocked up. It is suggested that a false platform was built to take all or part of the weight of the stone, and it then became an easy matter to elevate the unburdened end of the rocker. Under the whole device was then constructed a false platform, and the process of rocking upward was repeated time and again until the desired height had been reached. While this process entailed an enormous amount of labor, that was a plentiful commodity in Egypt in her days of glory. And the rocker method represented a great saving of material over the inclined plane.

The illustrations fail to indicate the task which is faced by the explorers in their study of ancient Egyptian ruins. For instance, the ground floor of the Palace of Merneptah was found sixteen feet below the surface of the earth at Memphis. Six different strata of occupations were found in the intervening earth The time of Merneptah is fixed at about 1350 B. C., and as Memphis was founded by Menes about 3,000 B. C., it is believed there are ruins of other palaces below that of Merneptah. But future excavation will be still more difficult, for one foot below the floor level of the present palace is the water line.

Builders and brick makers will be particularly interested in a discovery made by Dr Fisher in a small tomb at the cemetery of Denderah The arched entrance to this tomb was made of jointed or dovetailed, sun-dried bricks. What is said to be the oldest man-made arch in the world was discovered some years ago by another Museum explorer in Babylon, far down in the ruins of ancient Nippur, the Biblical Calneh. It is said to have been built about 4500 years B. C. But in this and in all other arches, whether of Egypt or Babylon, the bricks were not jointed. And a curious fact is that search of other tombs failed to reveal any general use of the discovery. It has been only within the last fifty years that the linked brick has come into general use again in building construction.

Industrial Skin Hazards

IT is becoming more and more in evidence that skin diseases of various types are prevalent among workers, and that in many instances these conditions result from the manufacturing procedures in which the worker is engaged. Very little information is available as to the frequency of these diseases, the industrial processes that produce them, the kinds and severity of the skin lesions, the methods of profitable treatment, the methods of protecting the workers against exposure, etc. For this reason a committee has been appointed by the Health Service Section of the National Safety Council to compile all obtainable information of this nature and to make such recommendations as appear to be helpful in the prevention and control of these industrial skin conditions.

This committee will serve as a clearing house for the collection and disseminatin of data on the best methods of preventing and controlling skin diseases, and the most satisfactory methods of treatment. Progress has been made in the control of skin conditions in many industries that should be made available to all industry. It is apparent therefore, that any assistance you can render this committee will react to your advantage.

Under "industrial dermatoses" the committee includes any noteworthy abnormality of the skin (hair or nails, etc.) that originated incident to industrial working conditions, or was aggravated by such conditions. This will include such lesions as rashes, eruptions, and inflammatory processes, hypertrophies (thickening or hardening of the skin) from hard use, such as on the hands or on the lips, low grade chronic skin diseases from long exposure to peculiar light rays or from certain heat processes, skin diseases from constant friction or pressure, loss of hair, etc. Properly speaking, most burns are likely to involve the skin, but inasmuch as the common types of burns from fire have been so well studied this committee will not include this particular skin lesion. Such burns as chemical burns, X-ray or radium burns, etc., are however of especial interest.

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

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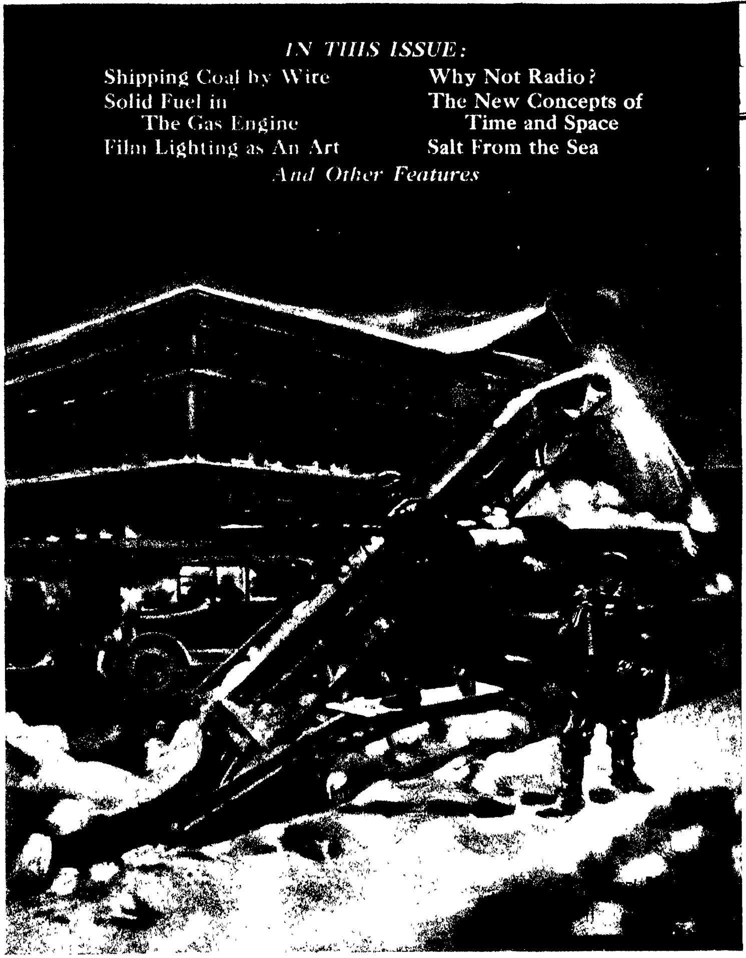
Shipping Coal by Wire
Solid Fuel in The Gas Engine
Film Lighting as An Art
Why Not Radio?
The New Concepts of Time and Space
Salt From the Sea
And Other Features



CLEANING CHICAGO'S STREETS WITH THE NEW SNOW LOADER AND MOTOR TRUCK.—[See page 153]

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Chart of Recommendations
for AUTOMOBILES
(Abbreviated Edition)

GARGOYLE

Mobiloils

A grade for each type of motor

How to Read the Chart

THE Correct Grades of Gargoyle Mobiloils for engine lubrication are specified in the Chart below

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

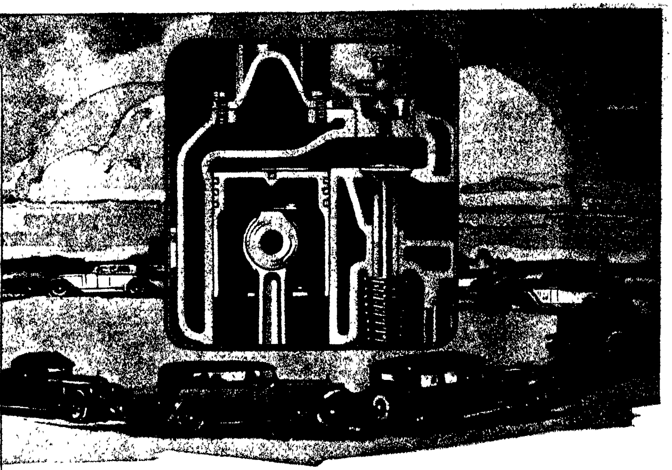
These recommendations cover all models of both passenger and commercial vehicles unless otherwise specified.

Where different grades of Gargoyle Mobiloils are recommended for summer and winter use the winter recommendation should be followed during the entire period when freezing temperatures may be experienced.

This Chart is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and constitutes a scientific guide to Correct Automobile Lubrication.

If your car is not listed in this partial chart, consult the Chart of Recommendations at your dealer's, or send for booklet, "Correct Lubrication" which lists the Correct Grades for *all* cars.

NAMES OF AUTOMOBILES AND MOTOR TRUCKS	1920		1919		1918		1917		1916	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Anderson			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Armleder (1 ton)	A	A								
All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Auburn (4 cylinder & 6-38)							A	Arc	A	Arc
(6 cylinder)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	Arc
(6-39 B) (Teetor H Eng.)					A	Arc				
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac	A	A	A	A	A	A	A	A	A	A
Chalmers (6-48)									Arc	Arc
(6-40)									A	Arc
All Other Models	A	A	A	A	A	A	A	A	A	A
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet (8 cylinder)			A	A	A	A	A	A		
(F A)			A	Arc	A	Arc				
(F B & 1 ton)	A	Arc								
All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cleveland	A	Arc								
Clydesdale (120 B)	A	A	A	A						
All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cole (6 cylinder)									Arc	Arc
(8 cylinder)	A	A	A	A	A	A	A	A	A	A
Cunningham	A	A	A	A	A	A	A	A	A	A
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Elgin	A	Arc			A	Arc	A	Arc	A	Arc
Essex	A	Arc	A	Arc						
Federal (Model S X)					A	A	A	A		
(Special)					Arc	Arc				
All Other Models	A	Arc	A	Arc	A	A	Arc	Arc	Arc	Arc
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Garford (1½, 3 & 5 tons)	A	A	A	A	A	A	A	A	A	A
All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Grant (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(Com'l Model 12)			A	Arc						
(Com'l) All Other Models	Arc	Arc	Arc	Arc						
Haynes (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(12 cylinder)	A	A	A	A	A	A	A	A	A	A
Holmes	B	A								
Hudson Super Six	A	Arc	A	Arc	A	Arc	A	Arc	A	A
All Other Models									Arc	Arc
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jordan	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Jumbo	A	A	A	A	A	A				
King (8 cylinder)	A	A	A	A	A	A	A	A	A	A
Kissel Kar (Model 48)									A	A
(12 cylinder)					A	A	A	A		
All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Kline Kar	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liberty	A	A	Arc	Arc	Arc	Arc	Arc	Arc		
Locomobile	A	E	A	E	A	E	E	E	E	E
Mack (Model AB & AC)	A	Arc	A	A	A	A	A	A	A	A
All Other Models									A	E
[illegible]	A	Arc	A	Arc	A	Arc	A	Arc		
Marmon	A	A	A	A	A	A	A	A	A	A
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	A
Mitchell (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(8 cylinder)									A	A
Moline Knight			B	A	B	A	A	A	A	A
Moon	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Nash (Quad)	A	A	A	A	A	A				
(Model 671)					A	A				
All Other Models	A	A	A	Arc	A	Arc				
National (6 cylinder)	A	A	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
(12 cylinder)			A	A	A	A	A	A	A	A
Nelson	A	A	A	A	A	A	A	A		
Oakland (8 cylinder)									A	A
All Other Models	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Oldsmobile (4 cylinder)	A	Arc	A	Arc					Arc	Arc
(6 cylinder)	A	A	A	A	A	A	Arc	Arc		
(8 cylinder)	A	A	A	A	A	A	A	A	A	A
Overland	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Owen Magnetic (Model M-25)					Arc	Arc	Arc	Arc		
All Other Models	A	A	A	A	A	Arc	A	Arc	A	Arc
Packard	A	A	A	A	A	A	A	A	A	A
Paige (6 cylinder)	A	Arc	A	Arc	A	A	A	Arc	A	Arc
(Cont. Eng.)	Arc	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
All Other Models	A	A								
Peerless (8 cylinder)	A	A	A	A	A	A	A	A	A	A
All Other Models					Arc	A	Arc	Arc	Arc	Arc
Pierce Arrow	A	A	A	A	A	A	A	A	A	A
(Com'l 5 ton)	A	A	A	A	Arc	[illegible]	Arc	Arc	Arc	Arc
All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	A	A	Arc
R & V Knight	B	A								
Rainier (1 ton)	Arc	A	Arc	Arc						
All Other Models	A	Arc	A	A	A	Arc	A	A		
Reo	A	Arc	A	A	A	Arc	A	Arc	A	Arc
Riker	A	E	A	E	A	E	E	E		
Rock Falls	A	Arc	A	Arc						
Saxon			E	E	E	E	E	E	E	E
Scripps Booth (4 cylinder)					Arc	Arc	A	Arc	A	Arc
(6 & 8 cylinder)	A	A	A	A	A	A	A	A	A	A
Standard 8									A	Arc
(8 cylinder)	A	A	A	A	A	A	A	A	A	A
Stearns Knight	B	A	B	A	B	A	A	A	B	A
Stewart (Buffalo)									Arc	Arc
(Com'l 1½ ton)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(Com'l ton)	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(All Other Mod.)	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Templar	A	A	A	A	A	A				
Velie (Model 34)	A	Arc								
(cylinder)	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
(Com'l 1½ ton)			A	Arc	A	Arc				
All Other Models	Arc	Arc	Arc	A	Arc	Arc				
Ward La France	A	A	Arc	Arc						
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White (16 valve)			A	A	A	A	A	A		
(1 ton)			A	A	Arc	Arc				
All Other Models			Arc	Arc	Arc	A	Arc	Arc	Arc	Arc
Willys-Knight	B	A	B	A	B	A	A	A	B	A
Willys Six	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc



Compression Mistakes

Expensive risks in using oil heavier than that specified in the Chart

THERE are motorists—you will find some everywhere—who think too much of compression. This leads to trouble.

To "rush hills" they want compression above everything else. Someone suggests a heavier oil. They try it. And sometimes a car will temporarily show better compression with heavier oil than with the grade specified in the Chart. But the driver pays the penalty later.

Then there is the user of a worn car, with worn pistons, piston rings and cylinder walls. He thinks that heavier oil will help fill the larger clearances caused by wear, so the change is sometimes made. Compression may improve but the motorist runs serious risks.

There are four leading reasons why "heavier oil" invites expensive risks:

1. The rate of wear on different makes and types of engines varies widely. Reasons: differences in designs used in parts, differences in construction, differences in manufacturing processes; differences in materials used; differences in the care which individual motorists give their cars.

2. Wear is not uniformly progressive in proportion to the mileage covered. All new engines must be broken in. Rubbing surfaces must be worn one to the other to produce smooth contact. During the "breaking in" period, wear is slight but rapid. Then, for a period, wear is gradual and dependent upon the degree to which the engine is correctly and efficiently lubricated and the care the engine is given. Finally, as power lessens, engine performance becomes erratic—and as noise develops the car requires overhauling and replacements before *any* oil can supply correct lubrication.

3. Piston clearances and piston ring fits do not alone determine the choice of the correct oil. Three other vital considerations are—operating temperatures, the designs of the lubricating systems (which are frequently unsuited to heavy oils) and the inability of some engines to use heavy oils without the quick production of carbon deposits.

4. The use of heavy oil will not necessarily insure greater oil mileage or freedom from "oil pumping." When piston rings become worn in their recesses in the piston, oil pumping increases, and low oil mileage and carbon deposit follows.

GARGOYLE MOBILOILS are specified in the Chart for *engine results*. Every engine factor is considered by the Vacuum Oil Company's engineers when they recommend the correct grade for *your* car. Badly worn cars need overhauling. Heavier oil may only multiply existing troubles.

The correct grade of Gargoyle Mobiloils specified in the Chart will lubricate correctly every friction point in your car.

Don't invite trouble by using "a heavier oil."

If your car is not listed on the partial Chart to the left send for our booklet "Correct Automobile Lubrication," which contains the complete Chart. Or consult the complete Chart at your dealer's. *Then use the oil specified.*

In writing, please address our nearest branch.

GARGOYLE

Mobiloils

A grade for each type of motor

Domestic Branches:	New York	Philadelphia	Detroit	Minneapolis	Kansas City, Kan.
	Boston	Pittsburgh	Chicago	Indianapolis	Des Moines

VACUUM OIL COMPANY *Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world* **NEW YORK, U.S.A.**

SEVENTY-SEVENTH YEAR

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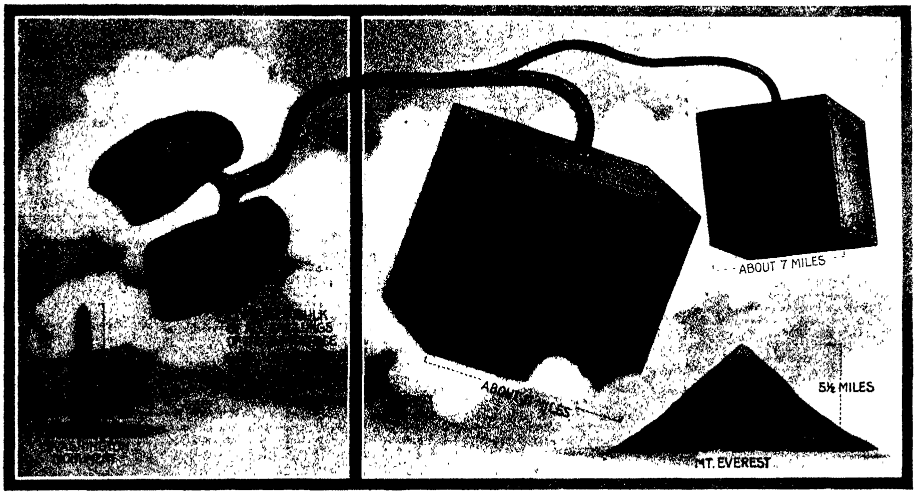

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Combined bulk of all the lungs of the human race, breathing 260 trillion cubic feet of air each year

"The Breath of Life"

By Charles Nevers Holmes

SOME of us waste more breath than others of us. All of us waste more or less breath, and it seems a pity that such a loss should be going on all the time. Our "breath of life" consists of several gases, as well as a small amount of water vapor, and impurities. We all know that oxygen supports life and that nitrogen dilutes the energy of the oxygen we inhale. In pure air, we find about 78 per cent of nitrogen and about 21 per cent of oxygen, the remaining 1 per cent containing very small amounts of argon, carbon dioxide, hydrogen, and other gases. Our "breath of life" consists of a mixture of these several gases, each independent of the others, and is not formed like water of *united* gases, oxygen and hydrogen. As we are very well aware, air is not nearly so heavy as water, indeed, water weighs about 778 *times as much as air*. That is to say, if a cubic foot of water weighs 62½ pounds, a cubic foot of air would weigh only about 1 3/10 *ounces*.

We draw a breath of air through the nose, it enters our lungs and there purifies the blood which is returning to the left auricle of the heart after circulating through the body. We draw in this breath, the oxygen in it purifies our blood, and then we expel this breath, now impure with carbon dioxide. The action of our lungs, expanding or contracting, is peculiar, inasmuch as our lungs expand or contract according to the expansion or contraction of the surrounding chest cavity in which they are placed. That is, our lungs are merely elastic bags, with a tendency to expand, whereby they are filled with air, an inhalation, and when they are squeezed by our contracting chest, they part with some of their air, an exhalation. In ordinary breathing, the average adult inhales and exhales, at each respiration, about 30 cubic inches of air. This *tidal* air is, however, only a small portion of all the air in our lungs, the remaining ⅞ being stationary. That is to say, after we have exhaled 30 cubic inches of air, there is still left in our lungs more than 200 cubic inches, about ⅛ of a cubic foot.

However, the total amount of air respired by only one *individual during a lifetime of threescore and* ten years is enormous. It is easy to compute that amount. If we take for an *average* 28 cubic inches, since a human being does not respire as much in childhood, then one of us inhales and exhales within a minute—at the rate of 18 respirations—504 cubic inches of air; within an hour, 30,240 cubic inches, in a day, almost 726,000 cubic inches; in a year, almost 265,000,000 cubic inches, in threescore and ten years, about 18,548,000,000 cubic inches, approximately 10,730,000 cubic feet. In other words, if a cubic foot of air weighs about 1.294 ounces, then each one of us would inhale during a lifetime of 70 years approximately 435 tons of the "breath of life!" That is, about 6 1/5 tons per year. In other words all the citizens of our 48 states respire annually 658,000,000 tons. Or, the whole population of the world, about 10½ billion tons of air. Therefore, the whole population of our world, in order to live, inhales yearly at least 2 1/5 billion tons of oxygen. Now, since our world's population inhales annually about 260 trillion cubic feet of air, it would inhale during the same time about 55 trillion cubic feet of oxygen gas. Accordingly, our world's annual respiration would fill full of air a tank which would be a mile square at its base and about 1,765 miles in height. And the world's yearly respiration of oxygen—the real "breath of life"—would approximate a similar tank about 370 miles in height.

Such is human breath—the "breath of life!" At every breath we exhale we begin to die, at every breath we inhale we begin to live. It is either respiration or expiration. Yet were the *proportions of our "breath of life"* to be changed a little, were it to contain more oxygen or less oxygen than it does, what a change would also take place in some of our bodily mechanisms! If we survived such a change, it would certainly affect, perhaps radically, both the pulsations of our heart and the respirations of our lungs.

Copper Etching Facts

IN the study of the microstructure of metals, the etching of the specimen is of fundamental importance. In the study of the general subject by the Bureau of Standards, copper was the first type to be considered. The principles underlying the etching of this metal are developed in a recent publication of the Bureau, Scientific Paper No. 390, and it is shown that oxidation is of prime importance. A list of typical etching reagents is given and the relative value of the various reagents is shown by means of illustrations of etching of various forms in which copper occurs

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Government Stepchild

THOSE who realize what a successful patent system means to American industry and American prosperity in general have once more succeeded in pushing their efforts in behalf of the Patent Office to the point where the Nolan Bill has emerged into the daylight of Congressional consideration. This bill is far from what those best acquainted with the situation would like, but on the principle that half a loaf is better than no bread they are working for it.

We do not know whether the general indifference to the fate of the Patent Office is due to lack of realization of its contribution to our position in our own markets and those abroad, or to failure adequately to picture its desperate condition. The questions asked at every Congressional hearing—asked year after year, despite the thorough fashion in which they are answered each time they come up—demonstrate colossal ignorance of the whole patent system, of its aims and its manner of achieving them. This ignorance exists not alone among those who have never had occasion to inform themselves and who therefore look upon the Patent Office merely as an agent for spending the Government's money for the benefit of a favored class, but equally among those who have been for years in contact with the facts.

The policy is plainly laid down in the Constitution and in the organic law of the land that it is the business of Government to encourage invention; that it is good business to do this and very bad business to omit it. If there still be any who believe that the patent creates an unjustifiable monopoly, who cannot understand that this monopoly is a just one and an expedient one, who still disbelieve that strong patents, and valid patents, and patents obtained within a reasonable time of filing, and prompt and efficient information service of the sort which only the Patent Office can be looked to to give, are among the strongest bulwarks of the proud position which the United States occupies in the industrial world, it would seem the part of supererogation to attempt further argument with these apostles of stubbornness. Accordingly, we say nothing on this side of the subject, confining our remarks to the effort to show, by new material and in its true colors, the truly desperate condition of the United States Patent Office.

Recently we published a brief account of the manufacture of synthetic rubber in Germany, by a process employing aluminum and acetone as basic raw materials. The present writer is anything but a chemist, but he was acquainted with the existence of this process, and had once been reasonably familiar with its general outlines, though these he had forgotten. On the appearance of the article we received a letter from one of the more competent patent examiners, a man of high standing, and one whom we happen to know as a good and conscientious worker. His field includes the subject of synthetic rubber. He gave us an awful calling down for printing this rubbish about aluminum and acetone. In all the references accessible to him in the Patent Office there was no mention of this thing, and he had never heard of such an absurd proposition as the manufacture of synthetic rubber from aluminum and acetone.

We want to emphasize that this is in no sense to the discredit of the man personally. It is altogether discreditable to the manner in which the needs of the Patent Office are being met—but that is all. The man of whom we speak is without doubt making an honest effort to keep up with the march of science in his field. But the demands upon his time and energy by routine work that ought to be performed by his subordinates, by executive work that ought to be performed by his equals and superiors, by the labor of instructing the vast and shifting army of temporary employees of low grade that occupy Patent Office vacancies at present salaries, by the work of examination and adjudication which properly falls on men of his class and of which he must shoulder more than one man's share—these demands make it out of the question for him to keep abreast of the times. If he could find the energy and the time to keep informed as he ought to, it is highly improbable that the Patent Office offers him more than half the necessary material, or makes this half decently accessible to him. With the present quarters, the present equipment, the present staff, the present salaries, the present working conditions it is not possible for the Patent Office to function in any direction at anything approaching full power.

In 1848 the patent examiner was classified by law among the very highest grade of professional men. The Principal Examiners got the same salary as members of Congress, the Examiner in Chief got the pay of a United States District Judge. The requirements of these positions have not been lowered, as any one who will read one of the examination papers imposed upon applicants will testify; but the positions themselves have been far debased. In 72 years of rising costs, patent office salaries have been raised, barring a war-time bonus of $240 which is universal and temporary, exactly ten per cent. Today a first class patent examiner, if he is lucky, gets as much as a fairly competent bookkeeper or a properly unionized elevator runner. Case after case has come up in recent years where a competent examiner has left the service to go into commercial employment of identical character at a salary double what Uncle Sam was paying him. And the contrast in working conditions between patent examining on behalf of the people and patent soliciting on behalf of manufacturers is unspeakable.

A member of the British Patent Office staff won the Eugene Higgins prize of $5,000 for the best popular essay on the Einstein theories of relativity. This could never happen in Washington; after meeting the demands made upon him by his Patent Office work, no conscientious examiner would ever have time or mental energy to master the subject, let alone expound it.

In many respects the Nolan Bill is inadequate, but it has traveled so much of the path toward ultimate passage that whatever of relief it affords can be had quickly. Everybody who is interested in betterment of the disgraceful conditions in the Patent Office ought to get behind this bill. Write to your Senators and Representatives today and get everybody else whom you can influence to lend his weight in support of the bill.

Conditions of Success in the Merchant Marine

SINCE the Spanish War, that is to say, for nearly a quarter of a century, there has been a more or less persistent effort to awaken the United States to the need for a merchant marine. The steady, and in late years phenomenal, growth of our foreign trade necessarily gave increasing emphasis to this movement. Before the war, it was estimated that we paid out about 300 million dollars per year in freight charges to foreign-owned shipping companies, and it was urged that if we had our own ships, this large sum of money would be diverted to the United States.

Today we own such a fleet, but, unfortunately, its profitable operation is handicapped by shipping laws which impose such a heavy handicap upon American ships that they cannot possibly compete with those which fly a foreign flag. This is true, in spite of the fact that the general increase in wages throughout the world has brought this element in the cost of ship operations well up to the American level. Thus, thanks to the laws governing the operation of American ships, our splendid new merchant marine finds itself handicapped by having to carry much larger crews than its competitors. The accommodations for our seamen are more spacious and comfortable, and so is the way they are fed; the menu in the fo'castle of some of our ships would make many a city clerk or mechanic green with envy. This generous provision for the American seaman, so far as health and bodily comfort are concerned, is all to the good and will meet with approval; but anyone who is familiar with the problems of shipping operations will realise that this advancement of the conditions of housing, food and work imposes such a handicap upon our ships that, if we are to compete successfully with foreign-owned ships and to carry all of our own trade and a reasonable share of the trade of the world, it will be absolutely necessary for Congress to make good the difference in the shape of a very substantial annual subsidy from the national treasury.

Either that, or our shipping laws must undergo a drastic revision.

Hitherto, those of us who have striven to awaken the United States to the commercial and naval advantages that would follow from its possession of a powerful merchant marine have found that the mere mention of the word "subsidy" has acted like a spark in a powder magazine, except among the peoples who live along the seaboard and have an intelligent and sympathetic understanding of the shipping question. There is this difference, however, between the situation today and then. Formerly, we possessed no merchant marine. Today we possess a great fleet composed largely of recently-built and thoroughly up-to-date freighters representing, so far as the one-half of it owned by the Shipping Board is concerned, an outlay of about four billion dollars of Uncle Sam's money.

It is certain that matters cannot go on as they are. Today the operation of these ships is a losing proposition. We cannot go out of business, for one reason because nobody in these times of terrific depression and abnormally low freights would care to buy our ships at any reasonable figure. That being the case, what does the nation wish to do with this splendid property? Are we willing to sell the ships for a mere fraction of their cost? Shall we let them rest at moorings? Or shall we bring a little national pride into the matter and send these vessels, well equipped and manned by American crews, to display the American flag on all the seven seas, with the assurance that the taxpayers of the country are, to a man, behind the great venture and will cheerfully make good a deficit which is largely due to world conditions over which we have no control.

Reducing the Bill for Federal Printing

HOW many people are aware that by far the greatest printing establishment in the world is located at Washington and run by the Federal Government? Furthermore, how many of us know that the annual bill for Federal printing reaches the huge total of 14 million dollars?

The Government Printing Office is engaged in printing that unique publication known as the *Congressional Record*, a stupendous undertaking in itself. In addition to this, it sends out by the ton various Government documents. Now, the annual cost of turning out printing at this rate is about 12 million dollars, and in addition to that, outside printing is done for the Government to the tune of two million dollars per year.

There is no question that the extravagance which marks all Governmental work has been flagrantly evident in connection with this outside printing. Mailing lists are not kept up to date, and consequently, members of Congress, the public press and many individuals who have no use for much of this printed matter, continue to receive it regularly year after year. And there is the tendency of Government officials, outside of those who are members of Congress, to have their speeches and pronouncements printed for broadcast distribution. We learn that from July 1, 1916, to September 15, 1919, the total number of speeches thus printed at public expense reached a figure of over 30 million copies, calling for over 894,000 pounds of white print paper and 558,000 pounds of manila envelope paper. The total cost of this item alone was 443,000 dollars. It is to be hoped that the committee which has this matter in hand will put in the pruning knife with a ruthless hand. We can call to mind no other waste of public moneys that has been so stupidly wilful as this.

Electricity

A Voltmeter Improvement is evident in the recent offering of a British electrical instrument manufacturer. This improvement takes the form of a six-range switch which gives values for the calibrations of the single scale of from .001 to 1,040 volts. The switch handle is made in the form of a flat rod, which may be pulled more or less out of its slot in the side of the instrument case. A series of graduations on the side of this slide indicates how the scale reading should be multiplied in order to obtain the correct value for any setting.

Electric Truck for Foundry Use.—A storage-battery truck of exceptionally rugged construction has recently been developed for foundry use, such as in packing and transporting pots in the process of making malleable castings. The truck has a carrying capacity of 4,000 pounds. The lift mechanism is a completely enclosed unit, all parts of which run at slow speed in oil baths. The driving unit consists of a totally enclosed motor directly connected to a worm gear driving through a four-bevel pinion differential to the wheels. All units are standardized and built on an interchangeable system. The complete unit is 12 feet over all in length and weighs 3,600 pounds.

Transatlantic Radio Telephony.—The realization of transatlantic telephony for commercial purposes is another object of the radio central installation, according to E. F. W. Alexanderson, the well-known radio engineer. Transatlantic telephony will no doubt, be a luxury for some time to come. The radiation intensity needed for telephony is much greater than for telegraphy, and a plant designed purely for telephony might prove prohibitively expensive. However the flexibility of the radio central where any number of antennæ can be combined when desired to produce a more efficient radiation will make an extra powerful transmitter available when needed, while the plant may be used in a more economical way at other times for telegraphy.

Flameproof Motors.—Experiments have been under way in England with a view to finding a means of protecting motors and other electrical equipment with a form of enclosure which, although affording a vent to relieve the force of an internal explosion, would not communicate a flame to the outside. Results have been obtained by flange, gauze and plate projection, but it appears that further research is necessary before there is conclusive evidence that any particular design can be relied upon to produce complete protection. There is a genuine demand for a flameproof motor in modern coal mining operations, in chemical works, and in motion-picture laboratories where vast masses of highly inflammable film are imperiled by the proximity of unprotected electric motors.

A Switch with Indicator Contacts meets the requirements when it is important to provide for the indication at some remote point of the position of a disconnecting switch. Such an indication is often of value at the point of control of circuit breakers in series with the disconnect, and serves as a positive check on visual inspections that have been made previously. In the new switch a separating insulating tube serves to provide for the making of an auxiliary contact with a small switch operated by the main blade. This secondary contact closes and opens the circuit of the signal lamps located at the distant point or points. The circuit through the auxiliary switch is not fully closed until the main switch blade is in a fully open or closed position. A positive safety lock prevents the accidental movement of the disconnect after it has been properly set.

A Radio-Call Signal has been developed by the British Post Office which is claimed to be particularly free from liability of interference from jamming or atmospherics, according to *The Technical Review*. The arrangement employs a single valve note magnifier and a thermo-ionic trigger relay, such as that described recently before the Institution of Electrical Engineers by Capt. L. B. Turner, and its special feature is a retardation device which prevents the call bell being operated before an uninterrupted "dash" 15 seconds in duration has been received. The current from the Turner relay actuates an ordinary Post Office electromagnetic relay, which starts charging a condenser through a very high resistance. It is only when this condenser is sufficiently charged that the dropping off of the first P. O. relay will cause the discharge of the condenser to affect a second P. O. relay, which in turn rings the call bell. The method of retardation depending upon charging a condenser slowly through a high resistance has been used by the Post Office on call signals for submarine cable circuits for some years.

Science

Bigger Women?—The director of Physical Education at the University of Pennsylvania states that statistics of women's colleges covering a period of sixty years show the average college girl of today is an inch taller than the college girl of 1860. These statistics also prove the modern girl is six or seven pounds heavier.

Shipping Explosives.—The Forest Products Laboratory specially designed a box in which to transport TNT and the box-testing machine which we have already illustrated has been used in making the tests. Boxes which are being tested and which will probably be accepted are approximately one foot square and eighteen inches long.

Nitration of Unbleached Pulp.—The series of tests to determine the suitability of woodpulp for nitrocellulose that have been in progress for some time at the Forest Products Laboratory indicate that bleached soda and sulphite pulps contain a comparatively high percentage of beta-cellulose and that cellulose from wood and cellulose from cotton represent different chemical aggregates. Nitration tests on unbleached pulps indicate that bleaching is unnecessary.

An Electric Scoreboard for Registration of Votes is now being considered by the Legislature of the State of New York. This would permit a quick and accurate count of votes cast, in addition to calling the roll. The only danger is that the electrical flash would be unrecorded. But this difficulty has been overcome by having the signal registered by a photostat which is perfectly feasible. Each assemblyman would have three push buttons, one for "present," one for "no," and one for "yes."

Elevator Accidents.—Considering the number of elevators in New York City, 13,500 in all, the percentage of accidents is very small indeed. On each of the three hundred and thirteen working days of 1919, six million passengers were carried through the 10,000 miles of elevator shafts, making a total of 1,878,000,000 passengers for the year, but only one passenger out of every 87,500,000 was killed in the elevator trips. This is owing to the excellent inspection by the office of the Superintendent of Buildings and also by the insurance companies.

An Interesting Exhibit is being held at the American Museum of Natural History to show the probable structural changes in the evolution of the forelimb from the wing to the paddle. Take for example the ancestry of the penguin, in which there was a forelimb modification before the flipper-like wing of the penguin was developed. To be adapted for flying, a limb must be light and at the same time strong enough to support a large surface of membrane or feathers spread for flight. For this reason the wing-bones of birds of flight are hollow, slender and long, but for swimming a limb must be strong and furnish support for a comparatively narrow paddle, so the bones are solid, short and stout.

Famous Trees.—The American Forestry Association announces a list of trees that have been placed in its hall of fame for trees with a history. The idea is to preserve famous historical trees and to mark the dates that had a great influence on American history, such as the arrival of John and Charles Wesley in America. The tree under which Wesley preached is an oak tree still standing on St. Simon's Island. The Webster tree is the tree on which the great orator hung his scythe, when he finally decided to go to Dartmouth College. To mark the 115th anniversary of the pathfinding expedition of Lewis and Clark a tree has been selected where they held one of their first councils with the Indians after leaving St. Louis. The tree was 150 years old at least before Lewis and Clark camped below it. Nominations to the Hall of Fame are made by various associations all over the country.

The State of Russian Science.—A movement is being started to provide Russian scientists and men of letters with literature which they missed so sorely. A certain amount of scientific research and some literary work still goes on notwithstanding the Bolsheviki, who are losing some of their hostility to scientific and literary work, and what is left of the once flourishing scientific life of Russia has now been brought together into two special rationing organizations which insure at least the bare necessities of life for them. Several scientific men have been particularly interviewed as to whether anything could be done to help them, as practically no books or publications have been received from abroad since the revolution. A strong committee of British scientists and literary men have been formed and there is now no obstacle for the transmission of this needed material.

Industrial Efficiency

American Coal in Northern Europe.—Opinions as to the prospect of the sale of American coal in northern European markets vary somewhat, but agree on the whole in the idea that the trade in the near future will assume a pre-war nature and condition except that it is likely to be in much larger volume—that is, the demand will be mostly, if not entirely, for special grades of coal for technical use, particularly for the manufacture of gas.

Corrugated Wire Glass.—By incorporating slight corrugations or ripples in wire glass, a leading wire glass manufacturer claims that he has evolved a glass that throws the light all over the building. Again, this glass is stronger and more durable, being made in one solid piece and not in layers with the wire between. It does not require special roof members for installation and can be used in connection with other corrugated materials for sky lights, side walls, and roofs.

A Substitute for Cork.—A chemical works at Bruenn-Koenigsfeld has been carrying on experiments with a view to finding a substitute for cork, says a Prague correspondent in the *Times Trade Supplement*, and these have now led to tangible results. Turf treated by a special patented process furnishes a material for insulation and building purposes that is said to be, in most respects, not inferior, and in some superior, to cork. The product is reported to be equally light, firm, and sound proof, to possess great insulating properties, and to be damp-proof.

Oiling Shafts from the Floor.—Accidents often result in the course of oiling transmission shafts in the usual way, namely atop a lofty ladder. With a view to eliminating the necessity of using a ladder for oiling shafts, an American company has recently introduced a long-distance oiler, so to speak, which can be operated by the man standing on the floor. A long tube, curved at the top, connects with the oil can, which is held in one hand while the tube is guided to the oil cups above with the other hand. The oil is forced up the tube by air pressure.

The Portable Elevator has come into its own of late, especially since the scarcity of buildings compelled manufacturers and others to utilize their space to the utmost. Portable elevators are now being employed for no end of purposes, such as piling barrels, cases, bags, bales machine parts, and crates. Any goods, bags included, may be piled up to the ceiling—straight up from the aisle. "Stepping" the packages or bags and wasting half the space along the aisles has been eliminated through the use of the portable elevator. Thus the storage space has been increased without a single change in floor space.

Wire Partitions for the Factory.—Security, order, efficiency—three things that go a long way toward making any plant what it should be—are gained through the use of partitions of some sort in order that tools and materials may not be lost, misplaced, or stolen. Again, where partitions divide each department into a working unit, there is less friction between workers. All unite to give the systematic effectiveness that is the aim of every factory executive. To simplify the partition problem there has been introduced on the market a system of sectional wire partitions which enables any one to erect stock rooms, tool rooms and divisions quickly and with the least trouble and expense. Every section is a complete standard unit, facilitating erection on the one hand, and changes on the other. Such partitions provide the security of a wall yet obstruct neither light nor air.

An International Chamber of Commerce has been formed at a Paris meeting as the result of the International Trade Conference held at Atlantic City a year ago. The constitution of the International Chamber as adopted by the convention provides for strong national organizations which will assure the due representation of the main economic forces of each country represented. A board of directors consisting of three members selected from each of the countries, Belgium, France, Great Britain, Italy and United States, will serve for a period of three years. The board of directors may select a limited number of additional directors from countries not already represented on the board. Paris was chosen as the international headquarters, a fine building situated at 3 rue Jean Coujon having been secured for the purpose. The purpose of the International Chamber of Commerce, as defined by the constitution, is as follows: "To facilitate the commercial intercourse of nations, to secure harmony of action on all international questions affecting commerce and industry, and to promote peace, progress, and cordial relations among countries and their citizens by the coöperation of business men and their organizations devoted to the development of commerce and industry."

The transmission tower that carries the power lines from the generating plant across the Allegheny River. 2. End of the conveyor that brings the coal from the heading to the firebox. 3 The shaft head of the Springdale development

How coal is being burned at the mine mouth to provide power for a wide area

Shipping Coal by Wire

The Springdale Undertaking—A Great Power House at the Mine Mouth

By Robert G. Skerrett

GENERATING power on a large scale at the mine mouth is one of the economic strides forced upon us by our participation in the World War. Recently a master central station of this character started service at Springdale, Pennsylvania, on the Allegheny River some miles above Pittsburgh. It is typical of what we are rapidly coming to in an effort to conserve coal, to cut down transportational charges, and to enable us to distribute energizing current at a moderate price throughout a wide radius of application.

It has been authoritatively declared that to mine 90,000,000 tons of anthracite in the course of a year involves the consumption in isolated steam plants at the mines, of quite 9,000,000 tons of coal, while if the needed power were generated for this service at a great central plant only 1,000,000 tons of fuel would be required. That is to say, it would be possible by such a procedure to effect a saving of substantially 89 per cent! With these facts before us it is comparatively easy to appreciate the significance of the Springdale Station, which is intended to furnish electricity to a considerable number of mines and to steel mills and steel furnaces lying within its zone of distribution. The ultimate machine capacity of the station will be about 300,000 kilowatts, and, in a general way, it typifies the master central plants that are contemplated for the proposed superpower zone of the northeastern Atlantic States.

The Springdale Power Station is the outcome of a contract entered into between the Government and the power company in the latter part of 1918. At the time of the agreement the Federal authorities pledged themselves to advance 40 per cent of the cost of the undertaking, this cooperation being essential to promote the prompt start of the enterprise. The scheme broadly was to aid the Pittsburgh district in manufacturing the basic materials for munitions, ships, etc. and to stimulate the output of coal for use elsewhere throughout the country. While the rearing of the structure and its equipping were effected too late to serve these ends during the period of strife, the station will, nevertheless, be a source of industrial strength for years to come.

The successful operation of a great central station within easy reach of coal is not solved merely by placing such a plant in the heart of a coal field and next door to a mine mouth. It is equally indispensable that there be immediately available an ample supply of water for condensing purposes, so that the hot water obtained by condensing exhaust steam can be led back to the boiler feed, thus lessening the amount of fuel to be burned to bring that water up again to the boiling point. The bigger the steam plant the greater the amount of water needed for this service. Accordingly, the Springdale powerhouse was placed right on the Allegheny River from which the filtering system draws a million gallons daily. This installation is designed to deal with the acid condition of the river water when the Allegheny is low; before the water reaches the boilers it passes through evaporators which dispose of harmful impurities or troublesome mineral matter in suspension.

The boilers are of the watertube type, each having 15,290 square feet of heating surface, equipped with a superheater, and capable of maintaining a working pressure of 350 pounds. Coal is delivered to these big steam generators by gravity from elevated bunkers, the fuel descending through chutes to underfeed stokers. Soot blowers keep the boilers clean so that they can run continuously at maximum efficiency for a month without any of them being shut down. The automatic stokers are driven by electric motors. The ashes are handled mechanically and drop into a large tank or hopper containing water, where they are immediately quenched. From this pit the ashes are withdrawn by bucket dredges and dumped into cars for removal. The point to be kept in mind is that only a handful of operatives is necessary in the fireroom and to deal with the ashes.

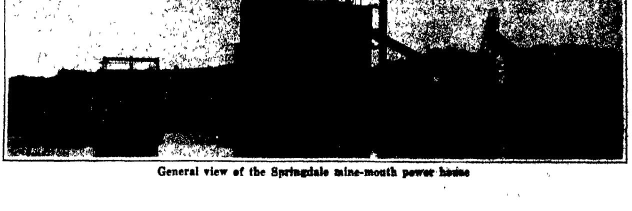
At the present time, the outgoing power service is taken care of by two of the latest models of steam turbo generators, each of which is rated at 25,000 kilowatts, that deliver current at 12,000 volts to the bus bars of the transmission system. In addition to these, there is installed a 2,500-kilowatt steam turbo generator which furnishes energy for numerous electrically-driven auxiliaries. The adoption of electric in place of steam drive eliminates a great deal of piping and does away with the radiation losses and leakage incident to the use of steam. This arrangement makes for marked economy in coal consumption. The house turbine, in case either of the main generators should be shut down, can be put on the line to help to meet the load.

Probably one of the most interesting features of the Springdale Power Station is its source of fuel and the manner in which the coal travels from underground to the capacious bunkers situated high above the boilers. The bed of coal that is being worked lies close by and extends under the river, the operating tunnels passing from shore to shore at a depth of 90 feet. The delivery or hoist shaft is just to the north of the powerhouse, and over this shaft rises the tipple which crushes and assorts the coal preliminary to passing it on to belt conveyors which carry the fuel to the station bunkers or to the neighboring storage yard. The belt conveyors, crushers, screens, elevators, etc., are all of them functioned electrically.

The vein of coal, which will probably suffice to meet the wants of the plant for half a century, has a general vertical thickness of 7½ feet, and the fuel averages 13,250 British thermal units per ton. The seam runs below strata of carbonaceous slate and sandstone—the latter about 25 feet through, and above this formation is a heavy bed of gravel. The sandstone, so far as exploratory borings reveal, is devoid of fissures, and, therefore, it is not expected that the miners will encounter any serious leakage from the river flowing past overhead. As a matter of precaution, nevertheless, drill holes are being sunk 75 feet in advance of the headings for the purpose of detecting any fractures in time to check inflowing water by means of compressed air. When the coal in the line of the tunnels has been removed, as the miners progress from west to east, the seam will then be followed throughout the property situated on the far shore, and the tunnels will thereafter serve as transportational channels through which the mine cars will travel to and from the hoist shaft connected with the tipple.

It will probably be wondered why the central station was placed on one side of the river while the coal field lies, in the main, beneath the opposite shore. This is easily explained. The site chosen for the structure was one of the few remaining good-sized tracts of land on the Allegheny River suitable for manufacturing purposes. It embraces an area of 80-odd acres overlying a rock formation and well above the sweep of the normal water level. As will be seen, in digging the tunnels, the power com-

(Con'td on page 163)

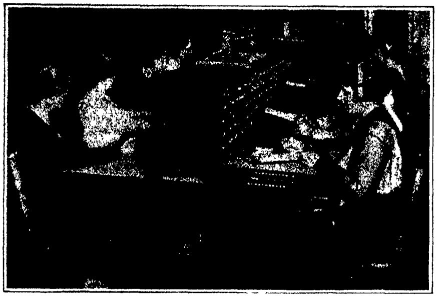


General view of the Springdale mine-mouth power house

How Pullman Space is Sold

By A. R. Surface

MOST of us have stood in front of a ticket window while the agent dickered over the telephone with a mysterious central authority somewhere for the privilege of selling us Pullman accommodations; and most of us have doubtless wondered just where this arbiter of our fate was located and just what sort of system it was that governed the business of making and selling these reservations. Those of us who have got aboard the train to find another in possession of the berth for which we held a coupon, with a porter and a conductor supremely indifferent to our protestations, will perhaps be willing to credit the statement of the *New York Central Magazine* that the systems in use heretofore have not been very satisfactory. But according to this authority, the scheme lately put into effect for the control of all Pullman business out of the Grand Central Station is as effective and as simple in operation as it is elaborate in design.



The Pullman central office where all reservations for trains out of the Grand Central are made and recorded

The equipment—all of which was specially devised and made to order for this purpose, even to the telephone arrangement—centers at a distributing board 18 feet long, 3½ feet wide and 2½ feet high This for its whole length is surmounted by a rack containing pigeonholes which accommodate 100 sets of diagrams for as many different outgoing cars

The distributing board is divided into three sections, and the whole table surrounded by comfortable, low swivel chairs for the twelve operators Each of the three sections contains the diagrams of all Pullman cars of certain trains, there are four distributors for a section, each operator being assigned certain trains On the table in front of the distributor is a duplicate set of index lights and she is fitted with head receiver and mouthpiece.

The perfection of the plan involved the installation of a very simply operated but most elaborately constructed special telephone system by the engineers of the New York Telephone Company The ticket offices at Grand Central Terminal and 125th Street Station, and the Consolidated Ticket Offices at 64 Broadway, 57 Chambers Street, 31 West 32nd Street, 114 West 42nd Street, New York; and 330 Fulton Street, Brooklyn, all are connected by direct wires leading to the distributing table. In turn each ticket-seller in the various offices is furnished with a card "key" showing just where the diagrams for each car and train are located on the distributing board His equipment also includes an individual telephone and set of buttons placed at his station at the counter or ticket window By pressing the proper button, the distributor is signaled in the section in which it is desired to obtain space, and the business is thereupon immediately completed by telephone.

A formula, adopted to reduce the number of words used in the operation, results in each transaction s being conducted in a few seconds, with the possibility of error reduced to a minimum

For example: A lower berth is desired on the "Twentieth Century Limited," Train No 25, Thursday, April 10th, New York to Chicago The following cryptic conversation goes over the wire between the ticket seller and the clerk at the Pullman distributing center

Ticket Seller: "25, Chicago, Thursday, April 10th, lower."

Pullman Clerk at Distributing Board "All right" (indicating that he can fill the order)

Seller '1776' (number of railroad ticket)

Clerk "Lower 12, Car 42, 25, Chicago, Thursday, April 10th, 1776"

Seller Repeats this

While this is being repeated, the Pullman clerk *checks with the diagram as data is called* The ticket number is recorded on the car diagram before the space is given to the ticket seller The staff of operators is composed of picked experts

There are *many advantages gained for the buyer* as well as the seller by the new system No longer must the traveler stand in line before a Pullman window, while he waits his turn to purchase a ticket for chair or berth When he buys his railroad ticket the same clerk is able to fit him out with Pullman space and, in addition, the passenger knows immediately whether the desired accommodations are available Orders are taken for any advanced period

The general public's telephone calls for Pullman accommodations are received also in this same office, but are received by a separate set of operators at another receiving table

Because of this concentration of distribution, space may be sold until two minutes before leaving time when the diagrams are sent by a messenger to the trains Furthermore, the manager is able to determine at any moment when it is necessary to add a car or more.

The absence of bell ringing and buzzers in the offices must be of untold comfort to the busy agents and the traveling public already has shown by many appreciative expressions its realization that the securing of Pullman space has been greatly simplified

A Rural School Museum

By Edmund Conaway

ANY part of a rural school can be a museum and since the whole of out doors is to choose from, little trouble should be experienced in making a selection Many people think that a museum should consist of a collection of specimens kept in a building, costing at least twenty thousand dollars Such is not the case since a museum does not need to be in a city or cost a large sum of money

Many rural schools have good collections of agricultural products, but there are many more things that should be added It is reasonable that the best collections should always be of the community in which the school is situated If agricultural the collection should be the best produced In coal mining communities, lumps of coal on which are found the prints of ferns or other forms of vegetable life This shows that coal was formed from vegetation and would also furnish material for an interesting lesson in the coal industry Those who live in the vicinity of oil fields can easily collect a bottle of crude oil and also sand from which the oil was produced This would be helpful in a lesson pertaining to the oil industry

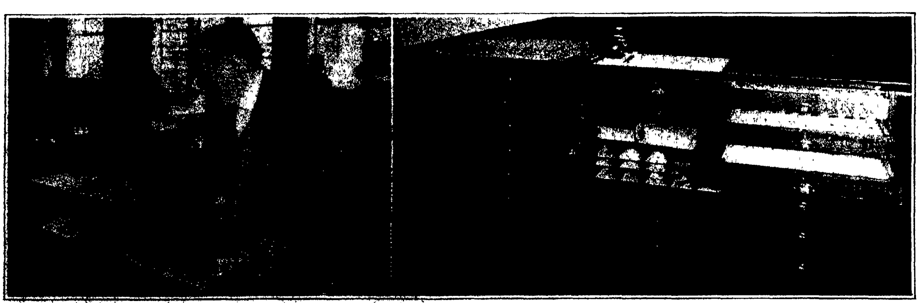
There are many things of historical interest in every community that could easily be collected, such as Indian relics consisting of arrow heads tomahawks and other implements of warfare These are found about the camping places of Indians which are known in most communities Most everyone living in the rural district has found some of these objects which he or she would be glad to contribute These would be helpful in teaching the important subject of local history

There are streams in every community along which are found stones of all sizes and shapes. Occasional collections of these should be made, accompanied by the children in order that they might have a better idea as to how they were formed

In the collection might be the head of a dog sheep or goat and also the skeleton of any bird that could be found There should also be small pieces of different trees showing a cross section with the annual rings of growth The annual ring of growth is defined as "The layer of wood produced by the diameter growth of a tree in one year, as seen on a cross section" Under normal conditions one ring is produced each year Trees that grow fast have wide rings distinctly marked, while those of slow growth have very narrow rings that can hardly be distinguished These rings would enable the teacher and pupils to determine the age of various trees and to make a study concerning their growth

The people of a school in one section of the United States could easily collect specimens from those of another People of the North and East know very little about the growth of cotton and peanuts A teacher could write to a postmaster of some town in the South or Southwest, asking for the name of some one who might send these plants

(*Continued on page 155*)



Left: The ticket seller with his automatic telephone, by means of which he can make instant connection with the Pullman clerk who has charge of the train in which he is interested. *Right*: The same view from behind the scenes, showing the place where the 'phone reposes when not in use

The equipment by aid of which the ticket agent can make Pullman reservations in a few seconds while selling the ticket

The New Concepts of Time and Space

A Brief Account of What Einstein Has Done to These Fundamental Notions

By Jumbo (Montgomery Francis, New York)

> *WHAT we present here, though altogether a praiseworthy effort, is not necessarily the second-best of the Einstein essays. We have selected it for this prominent position, perhaps because it is the one already referred to as appealing to our personal taste, but rather, we hope, because it seems to us of all the essays the one best suited to supplement the winner's Like Mr Bolton, Mr. Francis is obliged to bring in points which he has not the space to develop fully, and to suggest viewpoints which it is not possible for him to set forth in detail The topics which he does discuss fully, however, are just the ones which Mr Bolton slides over or excludes entirely, while he has comparatively little to say in duplication of the paragraphs in which Mr Bolton spreads his subject in greatest detail before the reader.*
>
> *The Judges and the present reviewer are united in admiration of the amount of material which Mr Francis has compressed within the limits of 3,000 words In this respect he stands easily at the head of the procession Indeed, his essay is so closely written that we are in some doubt whether this should be regarded altogether as an unalloyed virtue Certainly if its literary merit were any less, the compactness of his essay would make its reading a matter of some difficulty*
>
> *In justice to all concerned, we ought to say that the subheads and the two bracketed sentences in Mr Francis' essay, together with his references to our article of December 4th, have been supplied editorially* THE EINSTEIN EDITOR

WE have all had experiences, on trains and boats, illustrating our inability to tell, without looking off to some external body, whether we are at rest or moving uniformly, and when we do so look, to tell, without reference to the ground or some other point external to both systems, whether ours or the other be the seat of motion Uniform motion must be relative, because we find nowhere in the universe a body in the unique state of absolute rest from which alone absolute motion might be measured

True, the wave theory of light with its homogeneous space filling ether seemed to provide a reference standard for the concept of absolute motion, and for its measurement by experiment with light rays But when Michelsen and Morley looked for this absolute motion they found no trace of it (SCIENTIFIC AMERICAN, June 12, 1920, p 646 "Checking Up Einstein") To the physicist observational student of the external world nothing exists save observationally what he can never observe is not there So I *By no means whatever may we regard uniform straight line motion as other than relative*

As a further direct consequence of the Michelsen Morley experiment we have II *Light in a vacuum presents the same velocity, c = 186,330 miles per second, to all observers whatever their velocity of relative motion* In addition to being experimentally established, this is necessary to support I, for if light will distinguish between our velocities its medium is necessarily a universal standard for absolute motion But it is contrary to common sense to suppose that if I pass you at 100 miles per hour, the same light impulse can pass us both at the same speed, C. We feel, instinctively, that space and time are not so constituted as to make this possible But the fact has been repeatedly demonstrated And when common sense and fundamental concepts clash with facts, it is not the facts that must yield We have survived such crises, notably one where we had to change the fundamental concept of up-and-down (SCIENTIFIC AMERICAN, Dec 20, 1919, p 602, "The Nature of Things"), if another one is here, says Einstein, let us meet it

This the Special Theory of Relativity does It accepts Postulates I and II above their consequences it deduces and interprets For extensive demonstration of these I lack space, and this has been satisfactorily done by others so it is not my chief duty, but clearly they will be startling For the very ray of light which refuses to recognize our relative *motion* is the medium through which I must observe your system and you mine

It turns out that I get different values for lengths and time intervals *in your system* than you get, and vice versa And we are both right! For me to accept your "correction" were for me to admit that you are at absolute rest and I in absolute motion, that your measure of light velocity is right and mine wrong admissions barred by the postulates We have nothing to correct we can only recognize the reason for the discrepancy, and knowing our relative velocity, each can calculate from his own results what the other's will be We find, of course, that at ordinary velocities the discrepancy is many times too small for detection, but at relative velocities at all comparable with that of light it rises above the observational horizon

To inquire the "true" length is meaningless Chicago is east of Denver, west of Pittsburgh south of Milwaukee, we do not consider this contradictory, or demand the "true" direction of Chicago Einstein finds that the concept of length, between points in space or events in time, does not as we had supposed represent an intrinsic property of the points or the events Like direction, it is merely a relation between these and the observer—a relation whose value changes with the observer's velocity relative to the object If our ideas of the part played in the world by time and space do not permit us to believe this, we must alter those ideas [Let us see how we may do this]

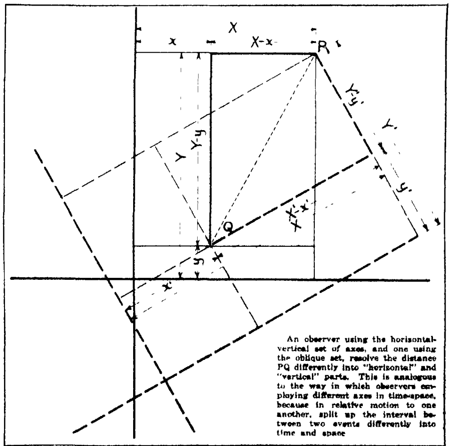
A Word of Points

To deal with points in a plane the mathematician draws two perpendicular lines, and locates any point, as P, by measuring its distances, X and Y, from these "coordinate axes" The directions of his axes acquire for him a peculiar significance, standing out above other directions he is apt to measure the distances X — x and Y — y between the points P and Q in these directions, instead of measuring the single distance PQ We do the same thing when we say that the railroad station is five blocks north and two east

The mathematician visualizes himself as an observer, located on his coordinate framework For another observer on another framework, the horizontal and vertical distances $X'-x'$ and $Y'-y'$ between P and Q are different. But for both, the distance from P direct to Q is the same. In each case the right triangle PQM (or PQM') tells us that:

$$PQ = \sqrt{(X-x)^2+(Y-y)^2} = \sqrt{(X'-x')^2+(Y'-y')^2}$$

Imagine an observer so dominated by his coordinate system that he knows no way of relating P with Q save by their horizontal and vertical separation His whole scheme of things would be shattered by the suggestion that other observers on other reference frames find different horizontal and vertical components We have to show him the line PQ We have to convince him that this length is the absolute property enjoyed by his pair of points, that horizontals and verticals are merely relations between the points and the observer, result of the observer's having analyzed the distance PQ into *two components*, that different observers effect this decomposition differently, that this seems not to make sense to him only because of his erroneous concept of a fundamental difference between verticals and horizontals



An observer using the horizontal-vertical set of axes, and one using the oblique set, resolve the distance PQ differently into "horizontal" and "vertical" parts. This is analogous to the way in which observers employing different axes in time-space, because in relative motion to one another, split up the interval between two events differently into time and space

We too have created a distinction in our minds corresponding to no sufficient reality Our minds seize on time as inherently separable from space We see the world made up of things in a continuum of three space dimensions, to make this dead world live there runs *through it a one-dimensional* time continuum, imposed from without, unrelated

The Four-Dimensional World of Events

But did you ever observe anything suggesting the presence of time in the absence of space, or vice versa? No, these vessels of the universe always occur together Association of the space dimensions into a manifold from which time is excluded is purely a phenomenon of the mind The space continuum cannot begin to exist until the time dimension is supplied, nor can time exist without a place to exist in

The external world that we observe is composed, not of points, but of events If a point lacks position in time it does not exist, give it this position and it becomes an event This world of events is four-dimensional—which means nothing more terrifying than that you must make four measures to locate an event It does not mean, at all, that you must visualize four mutually perpendicular lines in your accustomed three space or in a four-space analogous to it If this world of four dimensions seems to lack reality, you will be able to exhibit no better reality for your old ideas Time belongs, without question, and not as an afterthought, but as part of the world of events.

To locate an event we use four measures: X, Y and Z for space, T for time Using the same reference frame for time and space, we locate a second event by the measures x, y, z, t Minkowski showed that the quantity

$$\sqrt{(X-x)^2+(Y-y)^2+(Z-z)^2-(CT-Ct)^2}$$

is the same for all observers, no matter how different their x's, y's, z's and t's; just as in the plane the quantity

$$\sqrt{(X-x)^2+(Y-y)^2}$$

is the same for all observers, no matter how different their x's and y's

Such a quantity, having the same value *for all observers*, is absolute. In the plane it represents the true, absolute distance between the points—their intrinsic property. In dealing with events it represents the true, absolute "interval," *in time and space together* between the events. It is not space, nor time, but a combination of the two. We have always broken it down into separate space and time components. In this we are as naive as the plane observer who could not visualize the distance PQ until it was split into separate horizontals and verticals. He understood with difficulty that another observer, employing a different reference frame because in different position, would make the decomposition differently. We understand with difficulty that another observer, employing a different reference frame because *in uniform motion relative to us*, will decompose the "interval" between events into time and space components different from ours. Time and space are relative to the observer; only the interval representing space-time is absolute. [So common sense stands reconciled to the Special Theory of Relativity.]

Successive Steps Toward Generality

Is then our laboriously acquired geometry of points in a three-dimensional space to go into the discard? By no means. Jeans, investigating the equilibrium of gaseous masses, found the general case too difficult for direct attack. So he considered the case where the masses involved are homogeneous and incompressible. This never occurs; but it throws such light on the general case as to point the way toward attack on it.

Euclidean geometry excludes motion, save that engineered by the observer, and then the time is immaterial. Time does not enter at all; the three space dimensions suffice. This simple case never occurs where matter exists; but its conclusions are of value in dealing with more general cases.

When we look into a world alleged to be that of Euclid and find motion, we may retain the Euclidean concept of what constitutes the world and invent a machinery to account for the motion; or we may abandon the Euclidean world, as inadequate, in favor of a more general one. We have adopted the second alternative.

Newton's laws tell us that a body free to move will do so, proceeding in a straight line at uniform velocity until interfered with. We do not ask, nor does the theory tell us, whence comes the initial motion. There *is no machinery to produce it; it is an inherent property* of Newton's world—assured by the superposition of the time continuum upon Euclid's world to make Newton's, accepted without question along with that world itself.

But Newton saw that his world of uniform motion, like Euclid's, was never realized. In the neighborhood of one particle a second is interfered with, forced to give up its uniform motion and acquire a constant acceleration. This Newton explained by employing the first of the alternatives mentioned above. He tells us that in connection with all matter there exists a force which acts on other matter in a certain way. He does *not display the actual machinery through which this* "force" works, because he could not discover any machinery; he had to stop with his brilliant generalization of the observed facts. And all his successors have failed to detect the slightest trace of a machinery of gravitation.

Einstein asks whether this is not because the machinery is absent—because gravitation, like position in Euclid's world and motion in Newton's, is a fundamental property of the world in which it occurs. His point of attack here lay in precise formulation of certain familiar facts that had never been adequately appreciated. These facts indicate that even accelerated motion is relative, in spite of its apparently real and absolute effects.

Gravitation and Acceleration

An observer in a closed compartment, moving with constant acceleration through empty space, finds that the "bottom" of his cage catches up with objects that he releases; that it presses on his feet to give him the sensation of weight, etc. It displays all the effects which he would expect if it were at rest in a gravitational field. On the other hand, if it were falling freely under gravitational influence, its occupant would sense no weight, objects released would not leave his hand, the reaction from his every motion would change his every position in his cage, and he could equally well assume himself at rest in a region of space free from gravitational action. Accelerated motion may *always* be interpreted, by the observer on the system, as ordinary force effects on his moving system or as gravitational effects on his system at rest.

An alternative statement of the Special Theory is that the observed phenomena of uniform motion may equally be accounted for by supposing the object in motion and the observer with his reference frame at *rest, or vice versa. We may similarly state the General* Theory. The observed phenomena of uniformly *accelerated* motion may in every case be explained on a basis of stationary observer and accelerated objective, or of stationary objective with the observer and his reference system in accelerated motion. Gravitation is one of these phenomena. It follows that if the observer enjoy properly accelerated axes (in time-space, of course), the absolute character of the world about him must be such as to present to him the phenomenon of gravitation. It remains only to identify the sort of world, of which gravitation *as it is observed* would be a fundamental characteristic.

Euclid's and Newton's systems stand as first and second approximations to that world. The Special Relativity Theory constitutes a correction of Newton, presumably because it is a third approximation. We must seek in it those features which we may most hopefully carry along into the still more general case.

Newton's system retained the geometry of Euclid. But Minkowski's invariant expression tells us that Einstein has had to abandon this, for in Euclidean geometry of four dimensions the invariant takes the form

$$\sqrt{(X-x)^2+(Y-y)^2+(Z-z)^2+(T-t)^2},$$

analogous to that of two and three dimensions. It is not the presence of the constant C in Minkowski's formula that counts; this is merely an adjustment so that we may measure space in miles and time in the unit that corresponds to a mile. It is the minus sign where Euclidean geometry demands a plus that makes Minkowski's continuum non-Euclidean.

The Einstein Editor has told us what this statement means (Scientific American, Sept. 18, 1920, "New Concepts of the past Century", and Dec. 4, 1920, "That Parallel Postulate"). I think he has made it clear that when we speak of the geometry of the four-dimensional world, we must not read into this term the restrictions surrounding the kind of geometry we are best acquainted with—that of the three dimensional Euclidean continuum. So I need only point out that if we are to make a fourth (and we hope, final) approximation to the reality, its geometry must preserve the generality attained by that of the third step, if it goes no further. Einstein accordingly examined the possible non-Euclidean geometries of four dimensions, in search of one displaying fundamental characteristics which, interpreted in terms of space-time, would lead to the observed facts of gravitation. The *mathematics of this investigation is that part of his* work which, we are told, but twelve men can follow, so we may only outline his conclusions.

Einstein's Time-Space World

If we assume that in the neighborhood of matter, the world of space-time is non-Euclidean, and that its curvature or distortion or non-Euclideanism is of a certain

(Continued on page 155)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Gravitational Function

To the Editor of the Scientific American:

In your issue of July 24, 1920, under "Notes and Queries," replying to G. S. DeH., who asks, "Is gravity strongest at sea level or does it increase as one nears the center of the earth?" you make the statement, "Gravity is greatest at the earth's surface and diminishes as one goes either above or below the earth's surface."

It strikes me that this is a serious though rather common misconception of the truth. S. E. Coleman in his text-book, "Elements of Physics," published in 1906, makes a similar mistake, which he admitted only when confronted with the mathematical proof of the error.

His statement and yours above quoted would be true if the earth were a sphere of *uniform density* throughout; but this is not the case at all, the average density being about 5.56 while the extensive outward "shell" reaches only about half that figure. This would force the interior portion to have a density of perhaps twice the average.

Now as we pass within the body of the earth the "shell" penetrated does not exert a backward (upward) pull, but, as is well known, is neutral. We are, however, approaching the denser interior sphere, with a consequent increase in its gravitational effect, and this, for a distance, more than compensates for the neutralization of the attraction of the lighter exterior "shell" passed through and consequently gravity is meantime increasing instead of growing less as is often carelessly assumed.

If we assume a *constant* increase of density from the surface to the center of the earth, which is probably about correct, it will turn out that gravity instead of being "greatest at the earth's surface" will be greatest at a depth of about 600 miles—and 600 miles is about 15 per cent of the earth's radius!

If my reasoning is not approximately correct I *should be glad to see a discussion of the case.*

Forsyth, Georgia — Wade Hampton Stemple

A Protest from North Dakota

To the Editor of the Scientific American:

When I first commenced to read your paper more than thirty-two years ago, I though it to be a substantial paper, and so I believe it is in the present age, as a rule, only I have to denounce the Einstein Editor as more so unfair, than fair to the reader.

Maddock, N. Dak. — Olaf H. Loss

An Anticipation of the All-metal Airplane

To the Editor of the Scientific American:

Some eight or ten years ago you published drawings and detailed *description of an all-metal monoplane.* As I remember, the finished picture of this machine was on the front cover of the Scientific American and detailed drawings were on the inside. I cannot remember even the year in which this appeared, but it was before the World War—probably about 1908. In my estimation the idea was so far ahead of the times that it would be very desirable to reprint the whole article. At any rate—if at all possible to supply me with a copy—I will be very grateful. There were no wires on the outside; the wing spread was about 50 feet, but the wings were very narrow—and a speed of 150 miles per hour was predicted—all of which we have now—with the exception that the machine you displayed had finer lines. — J. Russell Jones

Tacoma, Wash.

[*The article referred to was published in the* Scientific American *of Oct. 22, 1910, and was republished in our issue of Aug. 14, 1920.*—Editor.]

Paper from Corn Husks

To the Editor of the Scientific American:

Before wood pulp became the main reliance for paper stock attention had been called to corn husks, which were found to make excellent paper. The fiber is very strong. It is true of the husk only, not the stalk or leaves, and is the part not valuable for feed when dry.

The corn crop now reaches three billion bushels, and for every bushel there must be several pounds of husks. Paper stock of spruce, poplar and other woods has become *so costly as to make the substitution of husks* possibly a profitable operation for the farmer, especially in the great corn growing states. The husking season, as with the grain itself, may be a matter of weeks or months, and the material deteriorates but little from exposure to weather, as the husks shed rain or dry quickly, and they are now a waste product. At only one pound of husks to the bushel of corn, a billion bushels would yield half a million tons of husks, and five pounds per bushel would be a low estimate or two and one-half million tons. Thrice that, if all could be utilized, would make a very material addition to paper stock. There is also the possibility of valuable by-products in the process of manufacture, as is the case with the coking of coal.

In order that the editor may see for himself how lavishly Nature provides a wrapper for one of the most valuable crops, and how tough and fibrous it is, I am sending to him by parcel post herewith two ears of corn unhusked, though not fully dry. The possibilities of such an abundant supply of an annual crop seem almost boundless. — Geo. S. Paine

Waterville, Me.

Sunspots and Terrestrial Temperature

To the Editor of the Scientific American:

During the past fifteen years the question of the fluctuation of solar radiations has been critically investigated. It has been determined that the spotted areas of the sun have a lower temperature than the general *photospheric surface.* Guided by this fact, Koppen, Newcomb, Abbot and Fowle and others have shown that the average surface temperature of the earth is slightly less during the maximum of the sunspot period than it is during the minimum phase of that period. At present the spot period is running to minimum and for several months the sun has been almost free from spots. The climatic effects of this periodicity of the output of solar radiation should justify the attention of meteorologists and result in studies of practical use.

Baltimore, Md. — W. E. Granville

Left Chief electrician of the Lasky studio with two of the spot lights used for unusual lighting effects. The light at his right has the switch on the standard, while the one at his left is of an improved model, with the switch on the light head *Center* How the spot light is employed for "back lighting"—an effect which causes the actors to stand out from the background and which makes for a sense of relief *Right* Operating a pair of overhead spot lights which are being played on the principals in an elaborate scene

Motion picture spot lights and how they are used to produce beautiful screen effects in our present photoplays

Film Lighting as a Fine Art

Explaining Why the Fireplace Glows and Why Film Stars Wear Halos

By Frederick S. Mills

Electrical Illuminating Engineer at the Lasky Studio, Hollywood, Calif.

AN important phase of motion picture production is the system of illumination Such terms as "Klieglights," "Sun Arc" and 'Spots are becoming familiar expressions, even to people who have never been within thousands of miles of a motion picture plant, and who have no technical knowledge of electricity

*A common question among 'movie" goers is why ar*tificial illumination is at all necessary—why the scenes cannot be photographed in the sunlight? This is not such a foolish question as it might at first appear, because in the early days of motion pictures very little artificial lighting was used, most of the scenes being photographed in natural daylight But, in the first place it will be seen that merely by the use of sunlight, no special effects, so important to the motion picture in its present advanced stage of artistic development, could be obtained In the second place, it must be understood that even on a clear day light values do not remain throughout the day, at the same intensity

At noon, perhaps, the light is very bright, but as the day begins to wane, say along about three or four o clock in the afternoon although it is not so perceptible to the eye, the value of the light, photographically, is very much lower It may so happen that a scene photographed at twelve o clock and one photographed toward the end of the day, will appear consecutively in the completed film The one would be bright and clear, the other a little darker in tone The first might be a 'close-up" of a player, and the next a longer "shot" of the same player The result would be a confusing effect as the two scenes were flashed on the screen—and one far from artistic or agreeable to the eyes This, of course, applies only to interior scenes

Thus as the industry has progressed, it has come about that to secure even, unaltered light all the way through the interior scenes, except where the light is purposely altered to secure effects, artificial lights are used almost entirely in American studios Even when the scene is taken in a setting which is out on an open stage a battery of artificial lights is used to insure a regularity in lighting, despite the time of day

"Klieglights" the big lights with double carbon arcs, which are generally diffused with ribbon glass or a semi opaque curtain to break the sharpness of the *light are used for general illumination, or as a prime* flat light to illuminate the entire setting or scene

The use of spotlights, which are small lights with single carbon arcs and condensers, is more involved The most common use of the spotlight is for backlighting By focusing a spotlight on the back of the heads of the principals, the image or images are caused to stand out from the background and the figures are more pronounced and thus better depth is obtained If this were not done, the figures would go dead against the background, no matter how far out they stood in the perspective Sometimes the error is made of putting too intense a spotlight on the hair of the player. This forms a sort of halo

Different types require different intensities of light for the back lighting, and a study must be made of this relation before ideal results can be obtained For instance, a blond does not require such an intense light as a *brunette* These various degrees of intensity are obtained by regulating the size of the beam of light and by the use of a diffuser which fits in front of the condenser, or lens, and is known as a "frost" because it is made of "frost" paper This "frost" tones down the sharpness and intensity of the light and makes it softer.

Spotlights are also used for what is known as cross-lighting For this purpose, the spotlight is placed so that it might throw a beam of light across the face of the player. This is for the purpose of destroying the effect of certain facial lines or expressions producing shadows, or shadows from the nose, chin, or other features. In the case of cross-lighting, another spot light is often placed exactly opposite the first so as to counteract any shadows cast by the first At times it is also necessary to place what is known as a "baby spot" on the floor and throw a beam of light up under the features of the player

The relation of make-up to lighting must also be studied by the electricians and cameramen A dark make-up requires a much more intense light than a lighter make-up; and when there are two persons in the scene, possibly a star and a leading player, if one has a dark make-up and the other a light, much care must be exercised in so regulating the light that it neither "burns up" the light make-up nor is of insufficient strength to light up the dark make-up. A happy medium must be struck in cases of this kind, so that all get equal benefit from the light value, as it is impossible to have a special light for each individual and attempt to keep it focused

(Continued on page 157)

Interior view of main studio floor of the Paramount studio in Long Island City, N. Y., showing the battery of mercury vapor lamps suspended from trolley rails on the ceiling

The Army School for Weather Observers

By George Gaulois

THOSE who read the army recruiting posters "Learn while you earn" may not realize what a wealth of choice the army offers to its learners Weather forecasting? Yes, the army teaches that, too, as well as 107 other courses, in its new program of education and occupational training for soldiers who enlist Camp Vail is one of the very few places in the world where a man can learn to be a meteorologist.

The class-room is a sunny, wind-swept platform Here are the instruments for measuring the temperature and pressure of the air, the direction and force of the wind, the amount of rainfall, and the action of the invisible air-currents a mile from the ground Readings are taken at exactly the same moment as in all the thirty-seven weather stations of the Signal Corps, widely separated throughout the country, and simultaneously with the readings of the numerous weather offices of the Department of Agriculture Any variation of time between these readings makes part of them useless or involves a considerable amount of correction

More than $200,000 has been expended on the meteorological apparatus at Camp Vail, and the course of instruction is being conducted by a highly-paid consulting engineer, Arthur A Rausch, formerly with the Weather Bureau. He is assisted by a staff of non-commissioned experts, and they have the exclusive attention of their class during the six months, that is, no student is allowed to follow other studies in the school at the same time

When he has completed the class-work at Camp Vail, a meteorological student may be stationed near Aberdeen, Md., where the Army heavy guns are tested For since artillery has been developed until a projectile may travel ten or fifteen miles, weather conditions enter vitally into the result. It costs several hundred dollars to fire one of the enormous engines of war used by the coast defense, and no steps are spared to guarantee a hit on the target when the signal is given—'Fire!"

Several varying currents of air will be encountered by the shell in its flight. These will not be the same as the particular breeze at the firing point, moisture in the air on one day will cause a projectile to behave differently, heat and air-pressure will also affect the accuracy of the calculated course of the shell, so, to the normal calculations necessary to make half a ton or so of steel hit a target far out on the horizon, mathematical corrections are made for the special weather conditions of the day These are based on information furnished by the Signal Corps

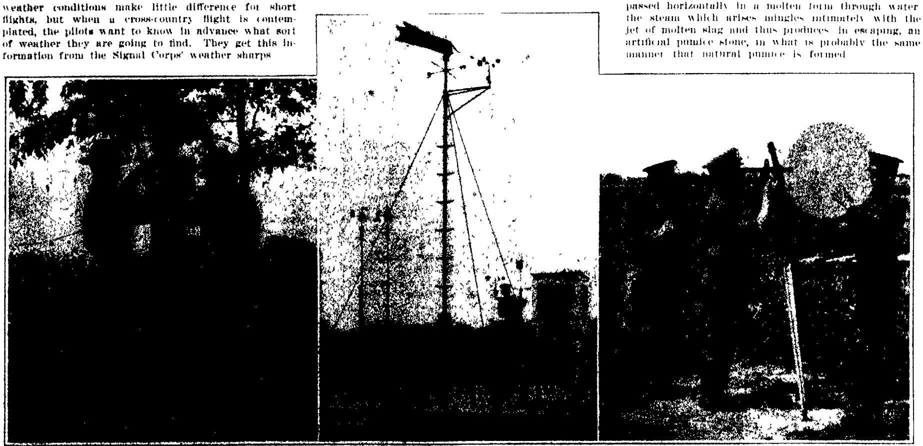
Or, the student of weather may be assigned inland to one of the fifteen weather offices which help the Air Service Aircraft have been so perfected that local weather conditions make little difference for short flights, but when a cross-country flight is contemplated, the pilots want to know in advance what sort of weather they are going to find. They get this information from the Signal Corps' weather sharps

It is largely on the account of the Air Service that these observations are made, for they always include records of the weather at an altitude of 1,500 meters This is not furnished by the weather bureau operating in the Department of Agriculture, except in about fifteen stations which were abandoned by the Army after the World War

In return, the Army stations are provided with the weather bureau's records, as both services work hand in hand It helps the accuracy of the weather bureau's predictions to know how the elements are behaving a mile up When the Americans got to France they found no such coördinated weather service as exists in this country and the Signal Corps was forced to establish its own stations No gas offensive measures of any size could be taken without reliable weather forecasts, except at great risk to our own troops

Everyone who served in the trenches knows, of course, the tiny wind-vanes that were mounted along

(*Continued on page 158*)



Photos by [illegible], Camp Vail

Left: Getting the weather by 'phone. Signalmen follow the meteorologists and fix their instruments to any handy tree *Center:* The Camp Vail establishment where a soldier learns to be a weather sharp. *Right:* Meteorological class at the Signal Corps school sending up a balloon to get the wind direction at one-mile elevation

How the Army teaches weather observing to those of its men who wish to learn

Round Seeds and Mechanical Ingenuity

By S. R Winters

HAIRY vetch the most widely grown of leguminous forage crops with the possible exception of sweet clover, usually forms companionship with grain in cultural practices Not unlike the Biblical parable of separating the wheat from the chaff, the hairy vetch seed must be divorced from other grain in order to obtain a commercial seed supply Ordinary seed separators are inadequate consequently there is on the market a simple but ingenious device which is described by the Bureau of Plant Industry of the United States Department of Agriculture as the keystone of the hairy-vetch seed industry

Devoid of moving parts, this separator functions by gravity and centrifugal force, the seed being fed into a hopper at the top of the machine and follows the devious course which winds like the thread of a screw The mechanism consists of three or more spiral chutes having a common center mounted on a vertical column, the outer chute being larger than the others and fitted with a vertical rim The mixture of vetch and other grain, which was a companion crop in farming practices, is fed into the hopper whence it is distributed equally to each of the small spirals Remove a slide and the conglomeration of seed whirls down through these spirals at a rate that would be considered as exceeding the speed limit if traveling on the National highways Only a few brief seconds intervene between the entrance of the seed at the top of the machine and their exit at the bottom

The separator that picks out vetch seed from that of the other grain grown in the same field

Fortunately, Nature came to the rescue of latent mechanical ingenuity Hairy vetch seed are round and smooth in formation while oats, rye, and other grains are flat-sided or oblong This machine capitalizes this essential distinction The hairy vetch seed roll swiftly to the outsides of the spiral where they bridge an edge or chasm and fall into the spacious outside spiral Seed not thus shaped do not glide so readily, but cling to the center of the spirals and are discharged from a central spout at the base of the device Healthy hairy-vetch seed are estranged from the faulty ones by a vertical partition situated at the base of the large spiral A spiral separator has a daily capacity of divorcing from 25 to 80 bushles of mixed seed

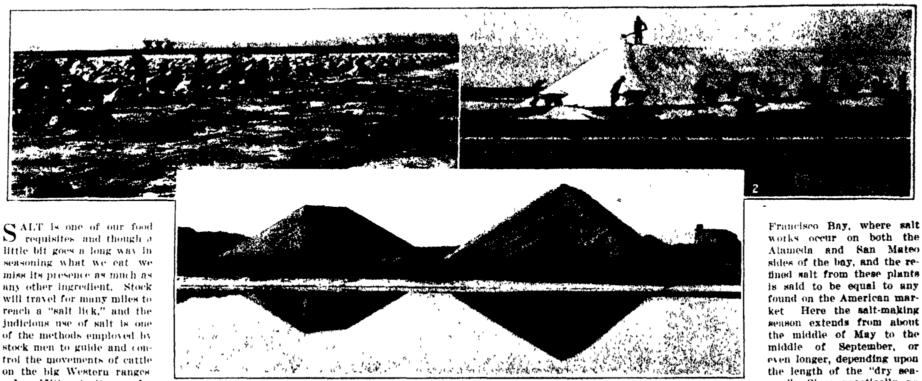
Making Porous Bricks of Slag

THE slag which is a by-product in foundries has long been used both in making bricks and in cement, but a new method of employing it has recently been devised in Germany According to *Stahl und Eisen* this consists in the production of extremely light bricks, resembling pumice stone in weight and appearance and employed mainly for building inside walls The slag employed in making these bricks is passed horizontally in a molten form through water the steam which arises mingles intimately with the jet of molten slag and thus produces in escaping, an artificial pumice stone, in what is probably the same manner that natural pumice is formed

Salt from the Sea

Some Details of a Little Known California Industry

By Arthur L. Dahl



1 Harvesting ocean salt in California 2 Piling the raw salt from ocean water to dry at San Francisco Bay plant
3 Salt pyramids piled for drying on San Francisco Bay

How salt is recovered from the waters of the Pacific

SALT is one of our food requisites and though a little bit goes a long way in seasoning what we eat we miss its presence as much as any other ingredient. Stock will travel for many miles to reach a "salt lick," and the judicious use of salt is one of the methods employed by stock men to guide and control the movements of cattle on the big Western ranges

In addition to its use for culinary and food purposes salt is largely employed in the meat-packing, fish-curing, ice-cream making and other industries to preserve food from deterioration It enters into the refrigeration process, and it is employed in the chlorination of gold and other metals Salt helps to form a glaze on pottery, and it is used in enameling and pipe works, and for curing hides Many chemical industries use salt brine in the preparation of chemicals having a soda base, such as soda ash, and caustic soda Altogether, salt has many uses, and the United States annually consumes more than 50,000,000 barrels

No country in the world has more abundant or more widely distributed salt resources than the United States, for salt is found, in some form, in all parts of the country, and the supply seems inexhaustible Many of our salt deposits and reservoirs of brines, are undeveloped for want of markets as our domestic demands and a constantly growing export trade is easily supplied from the salt works already in operation, and most of these can be greatly expanded if the occasion requires

Our salt supplies come from three different sources—the mining of rock salt in such states as Michigan, Ohio, Kansas and others, the making of salt from natural brines pumped from below the surface in the same and many other Eastern and Central States, from the evaporation of ocean water on the Pacific Coast, and at Syracuse, N Y Since the average value per barrel of all salt marketed in this country is in the neighborhood of forty cents, it is apparent that any method used in its manufacture must be exceedingly economical to be successful For this reason many large and excellent deposits of salt remain undeveloped because the competition from existing salt works is too keen

On the coast of California there has been developed in recent years quite an extensive industry in the manufacture of ordinary salt, or sodium chloride, from sea water California ranks fifth in salt production, practically all of which comes from the sea Aside from the salt works on Great Salt Lake, in Utah, and at Syracuse, N Y, practically the only solar salt plants in the United States are in California On San Francisco Bay there are numbers of these solar plants, and others operate in southern California, near Long Beach and San Diego

Ocean water contains on an average, 3.77 per cent of salt, although the salinity of ocean water varies in different localities, owing to evaporation and other causes For instance, the waters of the Pacific in the vicinity of San Diego contain an average of 4 per cent of salt, while that farther north is less

In the manufacture of salt by the solar process natural forces are utilized wherever possible, for it is only by this means that the business can be made profitable At each plant an average of over 1,000 acres of low-lying land is utilized as salt ponds The land is divided off into a number of ponds, each surrounded by earth dams or dikes, and connected with one another by flood gates If the conditions will permit, the water is let into the various ponds by the force of the tide, and where pumping is necessary, wind mills furnish the power

The center of the California salt industry is on San Francisco Bay, where salt works occur on both the Alameda and San Mateo sides of the bay, and the refined salt from these plants is said to be equal to any found on the American market Here the salt-making season extends from about the middle of May to the middle of September, or even longer, depending upon the length of the "dry season" Since practically no rains fall in California during the summer months, and the days are sunny and warm, the evaporation of ocean water can be carried on with great regularity and precision While the waters of San Francisco Bay are less salty than the ocean, owing to the discharge of the Sacramento and San Joaquin Rivers therein, yet the absence of fogs and the adaptability of the marsh lands of the bay overcome this handicap, and after the first of July the discharge of fresh water into the bay materially decreases, and the maximum salinity is secured.

At the solar salt plants the various ponds are known as storage, intake, receiving or tide ponds into which the salt water is received from the bay, the concentrating ponds, and the crystallizing ponds The ponds between the tide ponds and the crystallizing ponds are known as secondary or pickling ponds

The sea water enters the works through a canal or slough which connects with the receiving ponds, provided with flood gates that open and close automatically as the tide ebbs and flows In some plants, such as at Long Beach, new ocean water is being added to the plant constantly, but most of the bay plants introduce new water only at high tide, and store the water needed for the evaporating ponds

The sea water is run from one pond to another and allowed to remain in each for a given period, until gradually the water becomes more and more saline and this concentrated water is then let into the crystallizing ponds when crystals of salt have begun to form At some plants when the pickle in the salt ponds has reached a strength of 29 degrees B, the bittern with some salt in it is run into other ponds, where it evaporates until a concentration of 32 degrees B. is reached, when the mother liquid is allowed to go to waste.

On a general average, a plant will provide about ten evaporating ponds for one crystallizing pond, and during the salt season it is the aim of the management to keep all parts of the plant running in unison, so that a maximum of salt can be har-

(*Continued on page 159*)

Removing the raw salt from the crystallizing ponds

Solid Fuel for the Gas Engine

By Ralph Howard

THE world-wide shortage of fuels, and their constantly increasing cost, makes imperative their most efficient use. Not so many years ago, if a man insisted on burning in his power plant a fuel which had to be shipped to him from an excessive distance, or which was obtainable only at excessive cost, or which was usable for his purposes only at excessive inefficiency, it was nobody's business save his own. Today it is as much the business of the fuel producer and of the man who could use the fuel more cheaply and develop more effective heat units from it, as it is the business of the prodigal himself So much is this the case that a prominent authority on fuel conservation recently stated that the time is not far distant when the use of raw coal in the usual fire-box, with its attendant poor economy and generation of destructive gases will no longer be permitted

One way of avoiding this is to be found in the use of the gas producer This is in its bare essentials a device for the conversion of solid fuel into a gas suitable for use in an internal-combustion engine On the face of this statement, it would appear that theoretically at least, the producer might with some hope be looked to for a combination of all the advantages of solid fuel handling with all those of the internal-combustion engine Practically the gas producers heretofore available have not realized this expectation, and on this account the mention of the gas producer does not carry with it, to those who ought to know, the impression that we are talking of something that has scored an assured success But the producer, like everything else, is in a constant state of attempted improvement, and on the basis of its latest and best performance it ought to be recognized as a thoroughly efficient means of power generation

The gas producer is not in its general outlines a complicated mechanism. It consists of a steel shell, as shown in the figure, lined with fire brick and fitted with grates at the bottom, within a closed ash-pit The coal is fed into this shell through a specially constructed hopper at the top, which keeps the air away from the surface of the fuel bed Connected to the top of the producer by means of a large gas pipe is a scrubber, filled with coke or crushed stone, over which water is sprayed for cleaning and cooling the gas, and final cleaning is effected by drawing the gas at high velocity through a series of baffle plates At the other end of this line, of course, is attached the intake manifold of the engine in which the gas is to be used

Operation is simple As the engine runs the vacuum created by the piston displacement draws air into the producer through properly designed intake valves, causing the coal to undergo a partial combustion with free formation of gas This air is drawn through the burning fire bed, and with it a proportionate amount of steam is admitted The function of the steam is to keep the ash from clinkering, and by its decomposition into oxygen and hydrogen to enrich the gas

With the majority of the producers that have been offered heretofore if not actually with them all steam control has been the unsolved problem Sudden changes in engine load have interfered with the supply of steam, or the steam supply has not been sufficiently flexible to respond to these changes immediately, the result has been that with every change in load the quantity or the quality of the gas supplied has suffered But a producer lately placed on the market replaces the intricate and expensive steam controls which have been customary with a few simple parts that achieve their end with complete satisfaction Steam is made for this producer in the engine exhaust As the load increases, more gas is burned, more burned gas is exhausted, causing more pressure This increased pressure in turn forces more steam into the producer,

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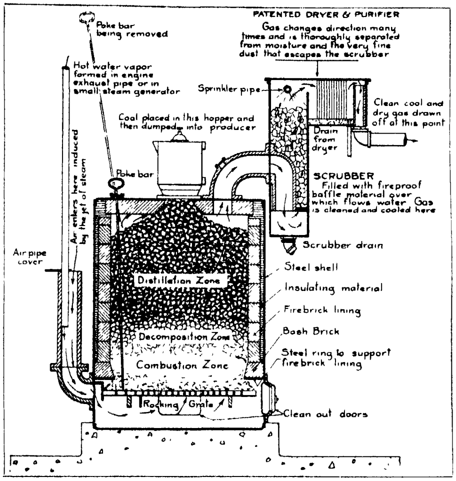
PATENTED DRYER & PURIFIER
Gas changes direction many times and is thoroughly separated from moisture and the very fine dust that escapes the scrubber
Poke bar being removed
Hot water vapor formed in engine exhaust pipe or in small steam generator
Sprinkler pipe
Clean cool and dry gas drawn off at this point
Coal placed in this hopper and then dumped into producer
Drain from dryer
Air enters here induced by the jet of steam
Poke bar
SCRUBBER
Filled with fireproof baffle material over which flows water Gas is cleaned and cooled here
Scrubber drain
Air pipe cover
Steel shell
Distillation Zone
Insulating material
Firebrick lining
Bosh Brick
Decomposition Zone
Steel ring to support firebrick lining
Combustion Zone
Rocking Grate
Clean out doors

Diagramatic cross-section of the latest style gas producer, showing the various parts and indicating their functions

Keeping Check on Factory Air

By Jacques Boyer

THE study of industrial atmospheres is one of the main tasks entrusted to expert toxicologists They must particularly determine traces of noxious gases which infest all factories and which are mainly carbonic acid and carbon monoxide In order to estimate with some precision the degree of pollution of confined air it must be analyzed quickly, but up to the present laboratory apparatus at the disposal of hygienists was both unwieldy and difficult to transport M Kohn Abrest, Director of the Toxicology Laboratory of the City of Paris, has facilitated the operations of his colleagues by bringing out a strong and simple apparatus permitting the making of quick analyses The most simple and practical of the apparatus which he uses comprises a pail of zinc, with a capacity of about 5 liters, in which the air to be analyzed is drawn in by letting water flow through flat bottles, each one independent of the others Metal tubes with faucets connect these receptacles disposed in battery formation on the copper cover, which may be unscrewed in order to allow the pail to be filled The speed of intake determined by experiment corresponds to 120 to 140 bubbles and a scale shows the volume of air aspired

In a general way the Kohn Abrest apparatus comprises four bottles, and thanks to their detachableness and rubber connections, they can be used for the simultaneous comparison of several suspicious atmospheres Two are sufficient however, for ordinary purposes, with the first, the carbon dioxide and monoxide are admitted while in the second, the presence of other noxious emanations is investigated

After a long series of experiments, M Kohn-Abrest has found that 'water of barium put in a single washing bottle permits the total absorption of carbonic acid Besides, as the carbonate of barium which is formed settles very quickly at the bottom of the vessel it is possible to dose with a little practice, the carbonic acid as fast as it collects

The simple estimate of a deposit of carbonate is sufficient to reveal to an experienced toxicologist the degree of variation of the atmosphere under study and he thus avoids protracting the experiment without necessity at an aspiration speed of two liters per hour it is possible to stop the apparatus after one hour in case of an air showing 5 parts impurities in 10,000 (normal air) at the end of a half hour in case of air 1 to 1,000 (confined air), and after a mere ten minutes in case of air of 4 to 1,000 (very unhealthy air) As for the analysis of the other acid gases, it can be done immediately the initial alkalinity of the water of barium used is known, it is sufficient to subtract,

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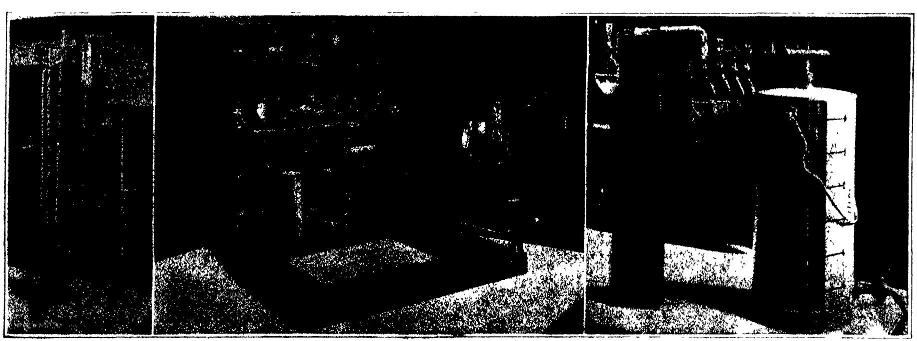
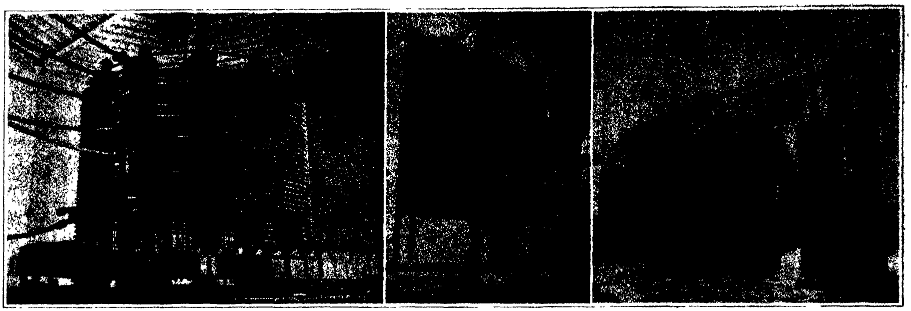


Left: The Ogier mercury "grisoumeter" for measuring the amount of fire-damp in the air. *Center:* Portable outfit of the industrial toxicologist. *Right:* The apparatus removed from the case and set up for work.

Rapid and accurate analysis of industrial atmospheres by a new French process



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Left: Huge aerial inductance coil which varies the wave length of the aerial circuit. *Center:* Rear of panel which controls the wave length of the transmitter. *Right:* One of the powerful arc type generators with its control unit at the right

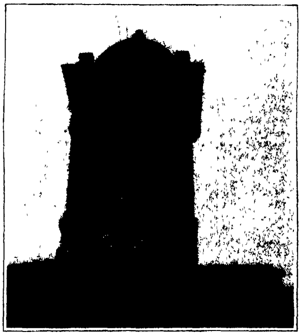
Some of the transmitting apparatus of the Lafayette radio station

Why Not Radio?

Some Technical Advances Which Have Made Wireless Commercially Practical

RELIABILITY is the very essence of commercial communication To that must be added speed, in the case of telegraph, telephone and cable communication And until wireless or radio communication proved that it was reliable and speedy, it could not serve in an everyday commercial way except in ship to ship and ship-to-shore traffic, in which fields it was alone

One by one the technical advances in radio have been chronicled in these columns, hence it would be but repetition to describe them here The Alexanderson alternator, the Goldschmidt alternator, the vacuum tube, the loop antenna, the arc generator, the photographic recorder and the phonographic recorder—these are but a few of the later day devices which have made radio communication commercially practical It is these devices which have made radio communication positive and reliable, no longer need transatlantic stations be held up for hours and even days by adverse atmospheric conditions, while messages pile up for transmission Again, the speed of transmission has been tremendously increased, because reception has been made positive and reliable at corresponding speed There was a time, true, when cables could handle a greater volume of traffic than the radio systems but today the tables are turned and radio systems handle considerably more traffic Thus the huge Paris station, which is now being constructed at Sainte Assise, France, will have a capacity equal to fifty ocean cables!



Tower of the main building with the lead-in cable from the antenna

A greater volume of traffic has obviously resulted in lower costs, particularly as regards overhead and investment charges so it is not surprising to find the present radio tolls considerably lower than corresponding cable tolls The press bureaus and newspapers were perhaps the first to appreciate the value of radio communication, but of late more and more business men have turned to this latest means

An interesting case of radio service to business men is presented by the inter-city radio system recently opened to the public between New York, Detroit, Cleveland and Chicago, in more or less direct competition with the telegraph and telephone lines connecting those cities The advantage of radio, in this case, is speed, for there is none of the delays sometimes experienced in the usual wire methods of communication. At the New York office, for example, two operators are at work, one receiving and the other transmitting. The office is located in the financial section, while the actual transmitting station is in the uptown section, some three miles away The receiving loop is on Staten Island, some seven miles distant. The transmitting operator in the downtown office controls the uptown transmitter by means of a telegraph line and relay arrangement, while the receiving operator receives the incoming signals impinging on the loop aerial on Staten Island, over a telephone line This dual operation permits of transmitting and receiving simultaneously, or two-way traffic at one time

Dual operation is maintained with Detroit and single operation between Detroit and Chicago and Cleveland. Messages can be 'phoned to the offices, where skilled 'phone girls take them down on a blank which is handed to the transmitting operator across the table The incoming messages, on the other hand, are copied down on a noiseless typewriter by the receiving operator, and handed to the telephone operator who notifies the addressee Of course, this telephone service is not new with this radio system, for it has been a feature of telegraph service for some years back. But the directness and simplicity of this radio system have much to recommend them, and it will be interesting to watch whether inter-city radio will spread to other localities

The main aim of radio today, however, is in the direction of long-distance communication rather than the short jumps from one city to another. Hence the several stations of high power which are now handling transatlantic traffic, such as New Brunswick and Belmar, N. J., respectively, the transmitter and receiver units; Chatham and Marion, Mass., respectively, the transmitter and receiver units; Tuckerton and Belmar, N. J., respectively, the transmitter and receiver units. These stations are working with Nauen and Eilvese in Germany, Stavanger in Norway, Carnovan in Wales, and Paris, Bordeaux and Lyons in France. There are several other powerful radio stations in Europe intended for long-distance work, which may be pressed into commercial service in the not distant future, as the demand grows

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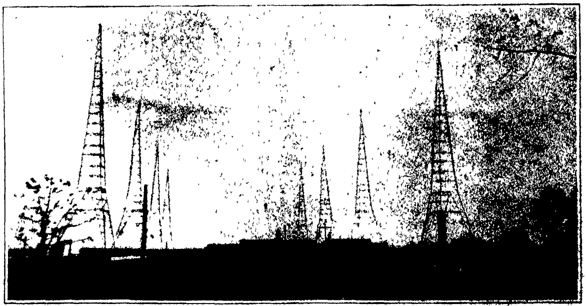


General view of the Lafayette radio station, showing the eight steel towers which support the antenna network and the station buildings

A New Job for the Clam-Shell Bucket

IN excavating for the basement of a large motion picture theater in Vancouver a layer of tough sandstone was encountered. This was broken up in the usual fashion with dynamite and churn drills, but the removal of the resulting débris from the hole was accomplished in a decidedly novel fashion, as shown by our illustration. A contractor gifted with the precious quality of imagination was unable to see any good reason why the clam-shell grab-bucket could not deal with the situation, and sure enough it turned out to be quite capable of doing so. The clam shell, operated by a stiff-leg derrick and a donkey hoisting-engine, quickly lifted the stones and boulders from the blast, loading them direct into five-ton trucks The big rock which figures in our picture we are told weighed about a ton, but as will be seen the bucket handles it without difficulty. A large amount of material was handled in this way at a minimum direct cost and at a great saving of time, the loading of a truck never consuming more than five minutes.—By *Theodore V. Berry.*

A Pile Driver for the Ferry Slip

THE accompanying photograph shows a specially designed pile driver for driving piles in both the inside and outside row at the ferry slips at Oakland. An extension fastened to the pile driver carries the hammer out over the first row of piles for the purpose of driving the outside row, thereby making it unnecessary to drive this row with a pile driver carried on a barge and floating in the ferry slip. By this means the piles can be driven without interfering with the movement of the ferryboats in and out of the slips of Oakland, California —By *C. W. Geiger*

Speeding Up Snow Removal

FOLLOWING the first heavy snow of the winter, a gang of fifty or sixty men for removing snow from the streets of Chicago was replaced by four men and the new snow loader shown on our cover this week Besides successfully replacing so many men, the machine was able to load so quickly that a great reduction was possible in the number of trucks required Four trucks, only, each being loaded in an average of five minutes, were needed where twelve were required before when most of their time was spent in waiting during loading.

No change had to be made in the usual scheme followed in removing the snow by hand Plows attached to trucks placed the snow in the long windrows in the gutters. In place of swarming gangs of men shoveling into high trucks, came the loader filling the trucks to overflowing so quickly that side boards for the trucks to carry a greater load became imperative

The machine is mounted on crawlers to gain the best traction It is powered by a four-cylinder truck type gasoline engine A two-armed apron scoops up and turns the snow on to a wide cleated belt which carries it up to discharge into waiting motor trucks This apron plow is adjustable It is possible to scrape the surface clean or leave enough space to pass over any obstruction Adjustment is made by the operator from his platform on the loader Skirt boards twelve inches deep keep the largest lumps on the belt and give it an effective carrying width of thirty-six inches The belt is positively driven, being fitted with roller chain on each edge

Chicago city officials put the loader to work the day after Christmas to remove the snow on Michigan Boulevard. After working the downtown length of the Boulevard, the machine worked across into the loop district. It ran for thirty hours without a pause, being operated by three shifts of eight hours each A minor repair was made and the machine continued One of the things that recommended it most highly to the officials in charge was the fact that it would work just as hard and tirelessly between midnight and morning as at any other time. This is the time when men are least efficient if they will work at all

Hatch tent for unloading in wet weather

Loading the spoil from blasting with a clam-shell bucket

Driving piles in the ferry slip without interrupting the service

Dry Stevedoring in Wet Weather

VESSELS are not delayed during the rainy season if they are equipped with hatch tents, nor is the cargo subject to damage from loading and unloading in the rain This clever use of a canvas or duck tent has saved time and money for various shipping concerns. Before the invention of these hatch tents a ship often had to lie idle until the storm blew over With the tents stevedoring proceeds without much regard for the state of the weather The tents are usually furnished in a size 32 feet square at the base and 35 feet from base to peak —By *B. L. Butler*

Cutting Metal with the Oxygen Flame

IT is not for so very many years that we have known the possibility of cutting metals with the oxidising flame. Even today, we do not have the clear insight into this process which we would have. There are many problems in connection with it that are not entirely clear, and some that are entirely vague Many others are in a controversial state, the exact nature of what happens upon the application of the flame under various conditions are as yet awaiting determination. An interesting discussion of the state of present knowledge and the outstanding problems will be found in the SCIENTIFIC AMERICAN MONTHLY for February, under the title "Severing Metals by Oxidation."

The Ionic Dissociation Theory

MOST really competent chemists are familiar with this theory in an offhand manner, but few have a thorough understanding of it This is rather deplorable, for the theory is a potent weapon in the hands either of the student or the research worker Mr Albert T Fellows, writing in the current number of the SCIENTIFIC AMERICAN MONTHLY for February suggests a number of interesting and important experiments which are within the easy reach of the most elementary laboratory, and which should do much to render the ionic theory clearer than it has been

Primitive Uses for Kelp

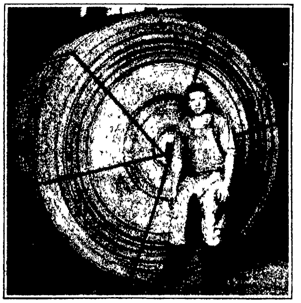
THE importance of kelp in the economic life of the Indians of the Pacific coast is seldom properly estimated A number of varieties are found in this part of the world which are suitable for human consumption, and which formed a material addition to the food stocks of these people In addition, it was freely used as a bait in fishing for sea urchins and other fish *In situ* the kelp growths have probably saved a goodly number of Indians from drowning by providing a place of anchorage for a canoe caught out in a bad squall Some of the larger varieties have stalks and bulbs which are useful as molds and even as bottles The fabric of the stem makes an admirable fishing line The seaweed serves nicely as chinking in the construction of houses Its value as fertilizer was well known to the Indians Likewise they were able to make considerable medicinal use of it In short, as narrated in some detail in the SCIENTIFIC AMERICAN MONTHLY for February, the rich marine growths were of very great value to the savage races of the Puget Sound and California coasts

A Battery That Is Different

A FRENCH inventor has recently put out a battery of novel design for which notable advantages are claimed The superficial solution is poor in mineral salts and rich in ammonia, so whether used for continuous or interrupted service the battery never contains corrosive salts The salts which are formed by long operation of the battery are deposited in the middle portion of the vessel, leaving the zinc as well as the surface of the liquid entirely clear, as a consequence the zinc is at all times fully utilized The performance of the new battery is summarized in the claim that a cell mounted in a vessel 10 centimeters square and 22 centimeters high, containing one liter of water and 125 grams of salammoniac with a zinc plate weighing 100 grams yields a total energy either in continuous or interrupted service amounting to 125 ampere hours A full account of the battery appears in the SCIENTIFIC AMERICAN MONTHLY for February

A Giant Among Conveyor Belts

TWO of the longest conveyor belts ever manufactured have just been made for the use of a big coal mine near Pittsburgh Each belt is 48 inches wide, 1,050 feet long and seven ply Each would make a strip of single fabric four feet wide and, if stretched to the maximum safe point 11,700 feet long—or 2¼ miles Over 5½ tons of surface stock were required in surfacing these huge belts with their area of 58,800 square feet And as seen in the picture, when rolled up ready for shipment each belt stood over eight feet high By *Lloyd Allerton*

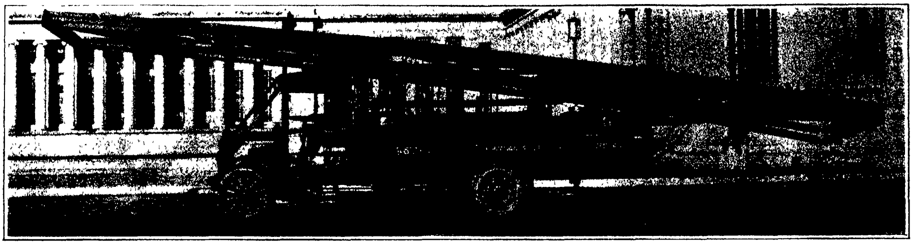


An acre and a third of conveyor belt

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Truck equipped with special body for handling structural iron, showing how easily long girders may be carried

Moving Structural Steel

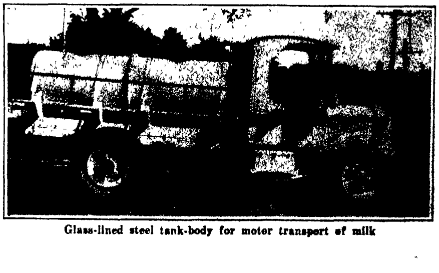
THE transportation of long heavy steel beams, pipes and girders has been a big problem for some time, and it has usually been solved by means of a semi-trailer or even a four-wheel trailer behind a motor truck. A Boston company has found a solution to this problem that is worthy of being described for the benefit of those who handle structural steel. The method permits the handling of long pieces by mounting a special frame work and body on a 3½-ton truck. The body, which is shown in the accompanying illustration, is 17 feet from the back of the cab and is 7½ feet wide. The frame of the body is built entirely of steel angles, having pockets to receive the stakes to which removable sides are attached. A piece of steel is attached to the front end, which is properly braced by having angle irons extend to the front end of the chassis. To this frame member is attached a frame work of angle iron extending across the radiator and approximately 18 inches wider each side than the width of the chassis. This frame receives the ends of long beams that overhang the body and makes it possible to haul structural members from 40 to 60 feet long without extending them over the top of the cab. This arrangement is very convenient for unloading at the destination because all the driver has to do is to take a crow bar and force the beam off of the frame and on to the ground. The frame work extending from the top of the cab makes it possible to haul steel trusses and girders from 40 to 80 feet long. A derrick arrangement for loading the truck makes it possible to load giant girders without much trouble. Any contractor handling bulky and unwieldy products such as long pipes, rails, built-up girders and columns will find the arrangement illustrated very practical and one that will give great satisfaction in handling an unwieldy load.

Tank Body for Milk Transport

MOTOR trucks have long been used for the transportation of milk in cans or bottles and have made many creameries and dairies practically independent of railroad schedules besides tapping new sources of supply. But the milk has been handled in cans which have an average life of four years, cost about $6.50 each, and cause considerable expense for cleaning and even loss of milk in spite of careful drainage. New glass-lined tank bodies that have recently been adapted to milk transport prove to be the most economical method of transporting milk by motor truck under certain conditions where their use proves to be profitable. The tank's strongest claim rests on its ability to save labor in the creamery and receiving station. In loading the truck the force of gravity will cause the milk to flow from the storage vats into the tank. With cans several men are needed to load the truck. When the tank of milk arrives at its destination, either the force of gravity or suction will force the milk out of the tank, whereas cans would require several men to unload. The tank can be flushed clean in a very short time by one man whereas each can must be handled individually and considerably more time is required for cleaning.

The temperature increase of pre-cooled milk has been found not to exceed a degree per hour even on the hottest day without taking any special precautions to insulate the tank. This means that a haul of 100 miles would only result in an increase of temperature of a few degrees by the time the milk had arrived at its destination. Of course, these tanks are not profitable in all phases of milk haulage because the wholesale delivery of milk to stores, hotels, and other large consumers is only practical with cans, whereas retail delivery is now done for the most part by using bottles as containers for the small amount of milk used by the housewife. Wherever a large amount of milk must be transported from one point to another, the tank, which is glass lined and without a seam, is far more efficient and economical. For example, many city dairies have small collecting stations at certain points. The cans of milk are brought to the station by farmers or by truck lines operated by the dairy. The milk is emptied into large vats and thoroughly cooled before it is ready for transportation to the city via the glass-lined tank equipped truck. The tank capacity on a 2½-ton chassis is 500 gallons. It is 36 inches inside diameter and 118 inches long. It will carry 4,150 pounds of milk. Three and one-half-ton trucks carry a tank of 800 gallons capacity. This is 42 inches inside diameter and has an over-all length of 138 inches. This tank carries 6,640 pounds of milk. The 5-ton truck chassis is fitted with a tank 54 inches in diameter and 144 inches long. This has a capacity for 1,165 gallons which is nearly 5 tons of milk. The capacity is increased by the use of platforms furnished with guard rails which provide space for a number of cans. The milk is loaded in the tank at the top opening. The valve at the rear permits complete draining of the contents in a very short time. Not only milk but any beverage may be economically carried in a tank wagon of this design.

Fleet of trucks that connects the factories of a big New England shoe manufacturer, at great saving of time and money



Glass-lined steel tank-body for motor transport of milk

The Motor Truck and the Shoe Factory

BIG savings in transportation costs, effected by the use of motor trucks, with corresponding savings in time by the elimination of delays in the shipping of goods are becoming more and more pronounced as manufacturers and others dependent upon efficient transportation systems for business success continue to increase their truck installations. They have found that the motor truck affords an independent transportation service dependent in no way on agencies outside their own organization—a condition that not infrequently is of inestimable value to the shipper when goods must be moved quickly. Such a service, providing the proper truck equipment has been installed, is always at the beck and call of the truck owner for the movement of freight either short or long distances. There is no waiting for railroad cars. The dependable truck is always in readiness for the haul.

As a concrete illustration that demonstrates conclusively that the high-grade truck is a money saver, a time-saver and a business-getter, may be recited the experience of a firm of shoe manufacturers of Brockton, Mass. Companies confronted by similar transportation problems can profit by studying the hauling methods employed by this company, which operates and controls nine factories with a total capacity of 24,000 pairs of shoes daily. One of these plants is in South Boston and another is in East Weymouth, Mass., each 20 to 25 miles from the parent factory at Brockton. A third is in North Adams, Mass., 160 miles to the northwest. Each factory performs a special function in the operation of the whole, making neces-

(Continued on page 160)

Shipping Coal by Wire

(*Continued from page 144*)

pany is incidentally obtaining fuel; and geological conditions, as already explained, render the superposed stream a negligible menace. At the same time, the nearness of the coal field virtually eliminates freight costs It has been estimated by the engineers interested that this factor alone will save annually, at present transportation rates, not less than $420,000 for each 100,000 kilowatts of capacity. There is reason to believe that the other mines in the vicinity will cease to yield in the course of the next quarter of a century, and consumers not so favored as the Springdale Station, will have to go farther for their coal and pay more for it.

The successful running of a commercial power plant of this kind is contingent upon an uninterrupted supply of coal at a fairly stable cost; and it is equally important to efficient results that the fuel be of a good and uniform grade In the present instance the mine will yield not only coal of one grade but this will be of a superior quality Therefore, it can be confidently predicted that the plant may be counted upon to get the most out of its splendid equipment and to turn out a kilowatt-hour of energy for less than two pounds of coal As may be realized, Springdale lies within the great coal producing area of the western section of Pennsylvania, and in that region there are hundreds of mines requiring purchasable power service An idea of the nature of this demand can be gathered from the fact that a group of something like thirty-five mines has a monthly consumption of 2,800,000 kilowatt-hours' In the tributary Pittsburgh district there are steel plants that use large blocks of electrical energy, and these patrons, with their divers needs, can be supplied from this great station without the movement of a single ton of coal upon the railroads in the vicinity—at least so far as furnishing power for operative machinery

This example of engineering advance and of the economic gains flowing from strategically located central stations serves admirably to emphasize the benefits to be realized on a wider scale through the interlinking of many power plants of a kindred character

A Rural School Museum

(*Continued from page 145*)

Specimens should be kept in a case and properly labeled with small strips of paper. Specimens of stones, skeletons of birds and animals, not known, should be sent to the State University or some other institution for identification

A case for the collection can be made by the pupils at a small expense The lumber which should be pine or poplar and free from knots or windshakes can usually be procured at the local sawmill A case four feet long, one foot wide, and five feet high would not be too large for a rural school. It could have four shelves, allowing sixteen inches at the bottom for the larger specimens and ten inches between shelves for those of smaller size The back can be made solid if so desired At the front and center a piece two inches wide extending from the top to the bottom, should be nailed Two doors swinging from the ends of the case can close at this piece Glass of suitable size for the doors can be procured at the hardware store This can be placed in a groove on the inside frame-work and made secure with putty. A collection such as described would be prized by the community since it concerns all its people.

The New Concepts of Time and Space

(*Continued from page 146*)

type already known to mathematicians; that the curvature of this world in the neighborhood of matter increases with the mass, and decreases as the distance from

(*Continued on page 157*)

Ten hours! More than a day's labor! Think of the cost in dollars!

Such was the result of a test between the flexible type of hack saw and an all-hard blade.

Both were designed to cut the same material! Both were carefully run to deliver the utmost service, but the all-hard blade demonstrated from the start that it cut costs by cutting quicker. On power sawing, where weight is needed to make the teeth of a blade "bite" into the stock, the soft-back saw is not practical. Because of its flexibility, pressure makes it "buckle" Without this weight the cost per cut is too high.

For economical power sawing the proper blade for the particular kind of material to be cut is indicated by the Starrett Hacksaw Chart It will be mailed to you, free. Also ask for Catalog No. 22 "B"

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Manufacturers of Hack Saws Unexcelled
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Testing Hack Saws

Every Hack Saw test has two distinct objectives. The first point to be determined is, what make of blade shall be selected as most efficient for the work of the shop as a whole. The second point, which is no less important, is—what particular blade made by the manufacturer whose brand has been selected, is best adapted to the conditions governing any particular piece of work.

The difficulties in the way of making sufficiently exhaustive tests to determine the all-round efficiency of various makes of saws has already been mentioned. To reach conclusions that are beyond doubt, every factor must be taken into consideration—the composition, temper, pitch of teeth, "set," gage, depth, and cost of the blade, the tension, pressure, speed and lubrication, and the characteristics of the material cut As it is a fundamental in comparative tests that only one variable should be changed at a time, the magnitude of the task of making complete comparisons is manifest. The influence exerted by a variance in the composition and temper of the blade and the pitch and "set" of the teeth has already been indicated these are factors beyond the control of the user of the saw

Effect of Difference in Gage

The gage of the blade, another of the elements determined by the maker, directly affects the cutting speed. Tests have shown that if two saws differing only in gage are used to cut the same metal, the first few cuts are usually made by both blades in the same time, but about the fifth or seventh cut, the thinner saw will be found to be cutting faster This is, of course, assuming that both saws are, except for the matter of gage equally well adapted to use on that particular kind or shape of metal The first half dozen or so cuts remove the extreme sharpness of the teeth and permit the element of "contact area" to come into play Obviously the thicker gage of one saw simply means more friction to be overcome and necessitates greater pressure to make the teeth cut To make a 14-gage saw cut as fast as one of 20-gage throughout a long series of cuts on the same material probably double the amount of weight would have to be put on the thicker blade toward the last of the test.

In selecting a saw to use on any particular job, it is worth while remembering that a short blade, though of lighter gage, is stiffer in proportion, and consequently can carry a coarser tooth —From *Hack Saws and Their Use*, published by The L S Starrett Co Athol Mass., for free distribution.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

METAL CONSTRUCTION.—D J Mooney and D H Emby, c/o Steel Wing Co, 48a Gillingham St, London S W, England An object of the invention is to provide a spar, longeron, or like device for airship construction which is composed of relatively thin sheet plates secured together in a manner to form a spar embodying the maximum of strength with the minimum of weight.

LANDING AND LAUNCHING DEVICE.—J I Crance 304 Madison Ave, Albany, N. Y. The invention relates to landing and launching devices for airplanes of the monoplane or biplane type The primary object is to provide means whereby an air vehicle may be launched in a comparatively restricted area, the same advantages being gained in landing the vehicle, when the device will act more or less as a brake or retarder

Electrical Devices

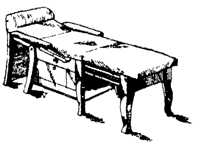
FAN BLADE.—A W Tucker, c/o Hotel Tulsa, Tulsa, Okla The invention relates more particularly to a ceiling fan blade The principal object is the provision of a blade which may be swung from a horizontal to a vertical position A further object is to provide a form of hinge with means for vertically adjusting the angle of the fan blade and holding it in its adjusted position

Of Interest to Farmers

FARM GATE.—G E Hardesty, Folsom, N M An important object of the invention is a farm gate in which the gate proper will be in all of its operative movements positively braced and constrained to travel in the proper path, thereby preventing distortion or excessive strain upon the gate or any of the associated parts Another object is to provide a post construction co-operating with the free end of the gate which will insure automatic locking of the gate in closed position

Of General Interest

COMBINATION CHAIR AND BED.—S and I Spector, 503 Ashford St Brooklyn, N Y The invention relates particularly to a chair which may serve as a bed An object is to provide a chair which is especially adapted for use by invalids, and which can be readily converted into a bed by a simple operation the back of the chair being hingedly connected so that it may be lowered and the underbody of the seat portion extending to support an upper cushion hingedly connected with the seat of the chair


A PERSPECTIVE VIEW OF THE CHAIR AS A BED

MUCILAGE TUBE.—M Machers c/o Geo J Gruenberg, 320 Broadway New York N Y This invention pertains more particularly to a device constructed to contain mucilage and facilitate its application An object is to so construct the device that it will readily stand upon one of its ends when not in use without affecting the discharge of the contents and will permit of regulating the discharge of the mucilage

LAWN SWING.—G H Bogenhagen, New Jacobson Bldg, Minot, N D An object of the invention is to provide a swing of the type described in which the swinging portion is suspended directly from supporting legs in such manner as to permit the occupant or operator of the swing to pass between the legs or to be used in a modified form in which the swinging portion may be suspended from a porch ceiling

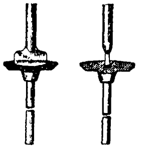
CLOSING DEVICE FOR RUBBER TUBING.—E O'Connor, 48 Ridgewood Ave., Newark, N J The object of the invention is to provide a closing device for rubber tubing such as is used for douche bags, fountain syringes and like devices and arranged to permit the user to conveniently manipulate the closing device when in position on the tube and to insure effective closing and opening thereof

MILK BOTTLE HOLDER.—M A. Pascale, 199 W 10th St New York, N. Y An object of the invention is to provide a milk bottle holder which is adapted to be secured to a door or other support, which will readily admit the bottle and which when the bottle is in the holder will operate to securely lock the holder in its closed formation and prevent removal of the bottle by unauthorized persons.

SHUTTLE CLAMP.—L O Roberts, 146½ Killingsworth Ave., Portland, Ore. The invention has for its object to provide means by which a shuttle may be firmly gripped and held during the winding of the thread The device comprises a clamp of substantially U shape, consisting of a body and arms extending at its free end and on its inner face a transversely extending groove for engagement by the edge of a shuttle face.

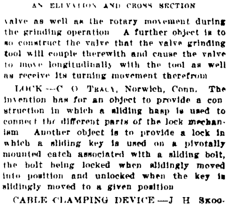
Hardware and Tools

VALVE AND GRINDING MECHANISM THEREFOR.—H C Brown, 854 Haddon Ave., Camden, N J An object of this invention is to so construct a puppet valve as to permit the positive longitudinal movement of the valve as well as the rotary movement during the grinding operation A further object is to so construct the valve that the valve grinding tool will couple therewith and cause the valve to move longitudinally with the tool as well as receive its turning movement therefrom


AN ELEVATION AND CROSS SECTION

LOCK.—C O Tracy, Norwich, Conn. The invention has for an object to provide a construction in which a sliding hasp is used to connect the different parts of the lock mechanism Another object is to provide a lock in which a sliding key is used on a pivotally mounted catch associated with a sliding bolt, the bolt being locked when slidingly moved into position and unlocked when the key is slidingly moved to a given position

CABLE CLAMPING DEVICE.—J H Skooman, 1514 Moffet Ave., Joplin, Mo The invention relates to devices for temporarily connecting cables, or other flexible members to other members, a purpose being the provision of a clamping or connecting device which is simple in construction and which effectively clamps a cable thereto without injury the parts of the device being so arranged as to automatically increase the gripping action upon the cable when the tension upon it is increased


VIEW SHOWING TOP PLAN OF THE DEVICE

SAW SET.—W J Ross, Riddle, Ore A purpose of the invention is to provide a saw set convenient to carry and handle by lumbermen for use in setting the cutting angle of saw teeth, and which can be quickly adjusted to saws in order to obtain adequate saw blade clearance for the blade when cutting through timber A further object is to provide a tool which will be strong and durable.

PIPE WRENCH.—G Cazenave, 310 Michigan Ave, Detroit, Mich. This invention has for its object to provide a pipe wrench wherein a relatively fixed jaw is provided and a relatively movable jaw loosely slidable on the fixed jaw, and a handle lever having a support adjustably connected with the fixed jaw, the handle having a cam for engaging the movable jaw to move it toward the fixed jaw

Heating and Lighting

HEATING STOVE OR FURNACE.—F. D. Cook, address Sam W. Miller, 1st National Bank Bldg., Blairsville, Pa The prime object of the invention is to so combine sheet metal and cast metal as to overcome or minimize the defects of these metals as used in the usual ways for producing a stove The invention includes a cast metal base, a cast metal fire pot thereon and a sheet metal shell being open at its lower end, and fitting snugly about the fire pot

HEATER AND VENTILATOR.—J. A. Greene, Long Beach Sanitarium, Long Beach, Cal This invention has for its object to provide a device adapted for comfortably heating a room with any type of heater wherein the fresh air that is distributed to the room is heated in a heating chamber separated from the combustion chamber, the heating and combustion chambers having separate and independent circulations

FRONT DISCHARGE CHAMBER OF MELTING FURNACES.—P Dhe, 42 Rue Notre Dame des Champs, Paris, France. The invention relates to an arrangement of front discharge chamber applicable to melting furnaces for the melting of materials such as metal, glass, volcanic rock and fusible clay. According to the invention the discharge chamber is divided into two compartments in communication with each other at their lower part, the first of said compartments receiving the melted material which issues from the melting furnace, while the second receives the decanted material and has a tap hole placed at suitable level

DAMPER.—J Tandy, 109½ S. Idaho Alley, Butte, Mont This invention has for its object to provide a device adapted for use in fireplaces to control the draft, wherein a frame is provided of a size to register with the opening of the flue and shaped to conform with the proper arrangement at the junction of the fireplace and the flue and having a damper capable of being operated from outside the flue for regulating the draft.

Machines and Mechanical Devices

APPARATUS FOR AND METHOD OF PREPARING VEGETABLES AND FRUIT.—N Rosenfeld 486 Shepherd Ave., Brooklyn, N Y. The invention pertains more particularly to a machine for cutting vegetables and fruits previous to the cooking operation The prime object is to provide a machine by which certain portions of a potato or similar food product may be cut throughout a portion of its body to permit of the access of the material in which the article is subsequently cooked

BOTTLE WASHER.—E W Dana, c/o The Dana Co, Platteville, Wis The invention relates to bottle washing machines especially adapted for use by dairymen who have a relatively small number of bottles to wash A special object is the provision of a double brush spindle machine in which the spindles are movable toward and from each other, and which may be hand or power driven, there being means for throwing the friction wheels into and out of operative position.

FRUIT PITTING MACHINE.—A V. Jennings, 708 St Nicholas Ave. New York, N Y The object of the invention is to provide a fruit pitting machine for quickly separating the meat from the pits of cherries, peaches, olives and other hard stone fruits. Another object is to accommodate different sizes of fruits undergoing pitting at the same time, and to separately discharge the meat and the stones from the machine

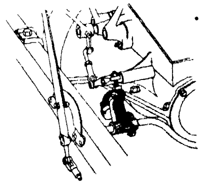
Railways and Their Accessories

BRIDGE WARNING.—W. Strimple, 40 Astor Pl., Jersey City, N J. The invention relates to bridge warnings and has reference more particularly to a warning consisting of a plurality of rigid suspended members positioned above a railroad track. Among the objects is to provide bridge warning members which are rigid so that they may not be bent or twisted out of shape, and which will not absorb water and freeze in the winter time.

LEAD CONTROL FOR VALVE GEARS.—C. T. Hardman, 2090 Johnston Ave., Nashville, Tenn. The invention relates to valve gears for locomotive engines. The foremost obpect is to provide an automatic lead control adapted more particularly for use with the Walschaert valve gear, the purpose being to automatically increase the lead of the steam valve as the engine speed increases, and when the reverse lever is hooked up for high speed.

Pertaining to Vehicles

SAFETY DEVICE FOR THE CLUTCH-CONTROLLING MEANS OF AUTOMOBILES.—J. Calcaterra, c/o R J. Cruice, 141 E. 23rd St., New York, N. Y. Two patents have been issued to this inventor on controlling and safety device which insure the natural position of the clutch of planetary transmission gears, particularly for Ford cars, and without modification of the original construction. The safety device is swung to set position with the movement of the controller shaft to apply the brake, to be engagable by a screw rocking with the clutch lever, but the Calcaterra device permits the release of the brake without releasing the safety device, the idea being to prevent the accidental running away of a car, when the brake is released, thus eliminating much emergency brake trouble by holding the clutch neutral until it is purposely thrown into low gear position by depression of the pedal lever, whereby the safety device is automatically restored ready to be again operated when the brake is applied. Also it permits the car to be manually moved without being opposed by the brake Stop means holding the device always in position to be operated.


PERSPECTIVE VIEW OF AUTOMOBILE WITH INVENTION APPLIED

MUD SHOE.—G M Glenn, 209 S. Glen St., Wichita, Kans This invention relates to mud shoes or treads adapted to be applied to a tire of an automobile for extricating themselves from mud holes, sand mires, and similar places An object is the provision of a mud shoe of simple construction, which can be quickly applied, and which provides gripping means on the tread surface and sides of the tire to effect a positive traction grip

AUTOMATIC STEERING DEVICE.—H. Dingman, address Herminghauser & Herminghauser, Fort Madison, Iowa The invention aims to provide a device, more particularly for use in connection with tractors, for drawing farm machinery, which may be integral with the front axle, or a supplemental axle to be attached to the steering axle, so that the same will work parallel to its last path of travel without the control of an operator, whereby he is relieved of all but the minimum of attention and may be in a position to adjust the plows or other devices

Designs

DESIGN FOR A BRASSIERE.—H. Fairband, 53 Bank St., Newark, N J.

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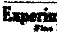

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The New Concepts of Time and Space

(Continued from page 155)

the matter increases; and that every particle of matter that is not interfered with travels through space-time in the most direct path possible *in that continuum*, then the observed facts of gravitation are accounted for as an inherent geometric property of this space-time world We usually say that the presence of matter distorts this world, and that this distortion gives the track of particles through the region affected its non-uniform character.

Gravitation then is not a force at all, it is the fundamental nature of things A body free to move through the world must follow some definite path Euclid says it will stand still, Newton that it will traverse a straight line in three-space at uniform time rate, Einstein that it will move in a "geodesic" through time space—in every-day language, that it will fall.

The numerical consequences of Einstein's theory are, within the limits of observation, the same as those of Newton's for all bodies save one—Mercury This planet shows a small deviation from the path predicted by Newton's law, Einstein's theory gives its motion exactly Again, when modern research showed that light must be affected by gravitation, Einstein's theory, because of the extreme velocity of light, deviates from Newton's where the speed is less a determining factor, and observations of starlight deflected by the sun during the eclipse were in much better accord with Einstein's theory than Newton's Moreover, the Special Theory predicts that mass is an observational variable like length and duration Radioactive emanations have a velocity high enough to give appreciable results here, and the prediction is verified, tending to support the general theory by supporting its limiting case

We like always to unify our science, and seldom, after effecting a unification are we forced to give it up Einstein for the first time brings mechanical, electromagnetic and gravitational phenomena within one structure This is one reason why physicists are so open minded toward his theory—they want it to be true

The Layman's Last Doubt

The final answer to any series of questions is inevitably "because the world is so constructed" The things we are content to leave on that basis are those to which we are accustomed, and which we therefore think we understand those for which this explanation leaves us unsatisfied are those which are new and unfamiliar Newton told us that the world of three-dimensional space with one-dimensional time superposed was so constructed that bodies left to themselves would go on forever in a straight line at constant speed We think we understand this, but our understanding consists merely of the unspoken query, "Why, of course, what is there to prevent?" The Greeks an intelligent people, looked at this differently, they would have met Newton with the unanimous demand "Why so, what is there to keep them going?" So if, in seeking an explanation of anything, we come sooner than we had expected to the finality "Because the world is so constructed," let us not feel that we have been cheated.

Film Lighting as a Fine Art

(Continued from page 148)

on that individual during the action A veritable jumble of different intensities of light would result.

"The Sun Arc," a more powerful light than either the Klieg or the spotlight, is used for lighting up large settings, and also for producing moonlight or sunlight effects through windows. These lights are generally not focused right on the scene, but are centered on interposed diffusing or reflecting mediums, which, in

On the Basis of Facts

The life of our country is built around its Public Utilities. Our social, industrial and Government activities could not exist today without the continued operation of their indispensable services.

That such services may be extended and developed to be of the greatest use to the greatest number, the Federal Government and practically all the states have appointed Public Service Commissioners as permanent tribunals to regulate public utilities with fairness to all concerned

Facts as to the past and studies as to the future, the Bell Companies find are essential to the proper management and development of their business This information is open to study by these Commissioners and through them by the public generally.

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turn, reflect the light, diffused and softened, on to the scene itself.

The carbon arc and the mercury lamps are used in practically all illumination of any nature whatsoever, in film production The kerosene or coal-oil flame will either not register at all, or will photograph black, under the stronger lights. So when an oil lamp, as used in settings of old-fashioned homes or country dwellings, where electricity is supposedly not available, is required in a scene, although the lamp has every outward appearance of an old-fashioned oil lamp, the flame within the shade is produced by a baby carbon arc

A very common scene in which electrical illumination is always used but rarely ever suspected, is the one in which a leading player in the dark or in a dimly lighted room lights a match and holds it up, cupped in his hands, to light a cigarette As he does this there is a glow over his entire face and a very novel lighting effect is obtained This *glow is produced not by a match*, but by a 'baby' carbon arc which the player holds in his hands and which is connected up by means of wires which run down through his sleeve and connect with a switch outside the scene

In scenes where flashlights are used, as in burglary scenes, the flashlight is equipped with a "baby' carbon arc, as the ordinary incandescent bulb in the head of the flashlight would not be of sufficient strength to register clearly

When a fireplace with a burning fire therein is shown in a scene, it is not the flames, as is perhaps generally supposed, which makes the fire bright and cheerful The fire itself would look dull were it not *for the fact that there is a carbon arc* underneath the rear of the hearth, out of sight of the camera, which throws its light through the gas flames and illuminates them

When *table* or stand lamps are used in a setting, apparently to light up the scene, they are generally equipped with an automatic "baby' arc There is a device by which three distinct degrees of current can be passed through the wires, thus making the light first dim, then bright, then very bright When a player pulls a tiny chain in the lamp, supposedly extinguishing one bulb, the light goes dimmer Then if he pulls another chain, supposedly extinguishing another bulb, *the current is again changed and* the light becomes very dim This is arranged by means of signals from director to electrician It is the general supposition of the audience that there are three bulbs in the lamp, and that these are extinguished one at a time by the player, whereas, in reality, there is only one light —the automatic "baby" arc—and this is dimmed or brightened by a control of the current by the electrician

We now have under development a device whereby we will be able to cut the intensity of a spotlight or Klieglight from full light down to zero, or raise the intensity from zero to full light without changing the spread of the beam This will make possible *a fade-out or a fade-in* with the lights and will provide many more novel and beautiful lighting effects in motion picture photography

I confidently believe, however, that in the course of a few years the present system of motion picture lighting will be replaced by a system of illumination by incandescent lamps The only light ray of photographic value is what is known as the actinic ray—the blue, violet and ultra violet end of the spectrum So far *the carbon arc and the mercury* arc are the best illuminants for producing this actinic ray, but experiments have already proven that the ray can be successfully produced with a new incandescent lamp which is still under development When this is adopted, motion picture players will no longer suffer such eye afflictions as "Kliegeyes," a common malady that comes from working under the glaring lights of the present system "Kliegeyes" is not caused, as is commonly supposed, by the carbon dust which is a product of the heated arc. On the other hand, this eye trouble is due to the actinic ray. The pupil of the eye regulates, by enlarging or diminishing in size, the amount of light which enters the eye The *pupil* cannot close down sufficiently to keep out this strong, actinic ray, and the result is an inflammation of the nerve system of the eye In acting, the player naturally opens his eye wide to "get over" *certain expressions*, This lets in more light The electrician, who stands directly behind the light and gets more carbon dust than anyone, rarely ever has Kliegeyes

Directors sometimes make the mistake of burning all their lights while rehearsing the players This strain is too great on the eyes, as the rehearsals sometimes continue for a good length of time. To prevent "Kliegeyes,' the director should first get his lights all set, and while rehearsing, burn one Klieglight—just enough to light up the set sufficiently to enable the players to work Then, when the action is all ready to be photographed the lights should be turned on *In the short space of time* while the camera is in action the strain will not be sufficient for any player to get "Kliegeyes" unless his or her eyes are unusually weak or inflamed

The cost of lighting scenes varies according to the size of the set and the consequent number of lights used For unusually large settings, requiring a great deal of light, the cost might range from twelve to fifteen dollars an hour for the lights

Of course, the motion *picture industry* is still comparatively new, and we are still in the experimental stage so far as lighting goes Not only in the studios, but in the movie theaters there is considerable room *for improvement* A spectator entering the largest of our cinema palaces is generally plunged from bright daylight into murky darkness, he passes through the reverse experience when he leaves the theater The eyes suffer a consequent strain, as the pupil does not have time to adjust itself to the sudden change The author has been working for a long time upon a lighting system for theaters that would eliminate this. He recently installed this system in one of the leading picture houses here in Los Angeles, and the results are reported to be highly satisfactory

When a person enters the theater, under this new lighting system, he enters first the *lobby*, which is *a* shade darker than the daylight outside The pupil quickly adjusts itself to this gradual change Then he passes into the foyer, which is a little darker still, and by the time he has reached his seat in the theater, his eyes are accustomed to the dim light The light is carefully graduated, and the eyes have suffered no strain They can see the screen perfectly.

The Army School for Weather Observers

(*Continued from page 140*)

the parapets to show if the wind came from the enemy's direction If it did, it brought the danger of gas, and therefore gas was expected Most of the effect of gas depended upon the element of surprise, so the little arrows helped win the war Each regimental intelligence officer was charged with the duty of sending to the rear a daily report on the weather, especially the wind, for the gas people's *information*

For the high altitude observations, a balloon filled with hydrogen, and two feet in diameter, is released and its angle of ascension, its drift and direction, are carefully observed, timed and recorded. These observations are made through a surveyor's transit, set up with the greatest exactitude over a fixed point and delicately oriented on a true northerly point.

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Salt from the Sea

(Continued from page 150)

vested profitably from the sea at all times. It is not possible to utilize gravity to fill and empty all of the numerous ponds, and many of the bay plants have installed a great number of small wind mills which pump the water from one pond to another. Usually this pumping serves to get the water into the highest ponds, from which gravity will convey it through the intermediate ponds into the crystallizing tanks. Since strong trade winds blow regularly during most of the summer months at San Francisco, these wind mills supply ample power for pumping, although electric motors or gasline engines are used for emergency power

Harvesting takes place from the crystallizing ponds, and the salt deposits are shoveled into wheelbarrows or tram cars and conveyed to the drying piles The larger plants have small railroads, with electric engines to pull the trains of salt cars, but most of the smaller plants harvest by hand The salt is not taken from the bottom of the pond, since the floor is usually made of mud, and this lower strata is left until the end of the season, when it is harvested separately and used for stock or in the manufacture of ice cream.

The salt when harvested is of a pinkish hue and still has considerable of the mother liquid remaining, and it is piled in huge pyramids or stacks to dry out before being milled. When made into small piles the crust sometimes becomes so hard that it is necessary to use a cross-cut saw to break it up into chunks When made into larger piles, it is more easily handled Bucket elevators, endless belts and other mechanical conveyors are used to transport the salt to and from the storage piles.

Crude sea salt contains considerable adhering pickle or bittern and dirt of various kinds, and washing is accomplished in various ways. The salt may be dumped into a hopper and flushed with hot brine, or it is sometimes sprayed with cold ocean water taken from the bay Usually the brine employed in the washing process is concentrated to complete saturation so that very little salt is dissolved in the washing After this first washing, the salt passes between rolls which crush it into "half-ground salt," and "three-quarters ground salt" It then goes to vats filled with artificial brine made from fresh water and salt, and consequently containing no mother liquid salts When washed in this solution the salt is stacked in heaps to drain If intended for the coarser uses of trade the salt is sacked in its present condition, but if intended for further refining the salt goes to vats which lead to centrifugal machines by which all adhering water is removed. It is then conveyed to driers, made up of long revolving cylinders containing steam coils and provided with fans that pump warm air through When dried, the salt is passed through heavy rollers which crush it into granular or powder form, and it is then sifted and graded for fineness, when it is ready for packing.

The amount of salt harvested from sea water averages from four to six inches in the crystallizing ponds, and at many of the plants two or more harvests can be secured each season. California produces about a million and a half barrels of sea salt per annum, which is sold throughout the Pacific Coast and to some extent in the Eastern States. In the interior of the State are vast deposits of salines containing a number of valuable products, including common salt, and some of these deposits are being worked for their borax, potash and other contents.

Solid Fuel for the Gas Engine

(Continued from page 151)

which is thus at all times instantly supplied with the exact amount of moisture necessary to meet the demands of the instant.

This producer is designed by Mr. A L Galusha of New York, and represents the fruit of many years' specialization in this field. In regular service it has shown an economic efficiency as high as 87 per cent, at full load; under average conditions it will not fall far short of delivering that proportion of the actual heat units in the fuel, in a clean rich, cool gas of uniform quality The average coal available for use in the producer contains 12,500 British thermal units per pound, this producer will deliver easily 10,000 of these in the gas The modern gas engine will deliver at full load one brake horsepower on this fuel value, the net result is then a fuel consumption of but one pound of coal per brake-horsepower hour

Another feature of the new producer that is usually questioned by prospective purchasers, and that only receives full credit after long use has demonstrated it, is the ability of the apparatus to go right on delivering its full rated capacity while the ash-pit is open for cleaning For those who are not acquainted with the merits or demerits of the ordinary producer it may not be out of place to state that there is no smoke and no chimney The space required is less than that necessary for a steam plant Allowing for economical intermittent service, the claim is made that the stand-by loss is a bare one-seventh that suffered in the use of steam A very notable point is that the range of fuel is almost limitless The use of a fairly decent grade of coal is of course recommended, but the manufacturers of the producer are most enthusiastic in their statements that anything that will burn, and some things that won't burn, may be used in the producer to generate gas Clean water is not at all necessary since steam is not used in working parts but is merely supplied as an ingredient of the gas

This producer is designed to replace the steam engine in the ordinary power plant of moderate or moderately large capacity The makers of the engine used during the war in our submarine chasers are operating their factory with a producer, at a coal economy of seventy per cent, the producer supplying gas to one of the company's own engines A prominent maker of natural gas engines for stationary use is installing the producer as standard equipment and finds it cheaper than the natural gas In pottery kilns, in supplying both heat and power in a chemical plant, and in ice plants the producer is in satisfactory service In the latter instance, a production of ten tons of ice per ton of coal burned under boilers has been replaced by a production of thirty tons per ton of coal burned in the producer This particular producer is eminently suitable for marine use, and it was in a vessel just arrived from the other side that we first saw it in operation. It is also in wide use in municipal power plants in small and medium-sized towns and cities.

Modern engineering skill often brings about a situation where what appears to the layman to be a roundabout procedure is the most efficient and the cheapest. There can be little doubt that the producer is a case in point. Within very wide limits the statement is a safe one, that a given amount of coal converted into gas in this producer and used in an internal-combustion engine will yield a much greater return in power, at lower cost of operation and lower initial cost of installation, and with increased reliability of operation, than if it were employed under a boiler to convert water into steam for direct application

Keeping Check on Factory Air

(Continued from page 151)

from the alkalinity which disappears, that definitely absorbed by the carbonic acid.

In order to find the carbon monoxide with this apparatus, use is made of the

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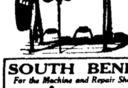

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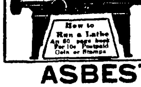

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method of Professor Armand Gautier, *based upon the reduction of iodic acid.* In this case, he attaches, beyond the ground opening of one of the washing bottles, an elbow-shaped glass manifold containing iodic acid which is electrically heated to around 100 degrees by means of a little storage battery Another washing bottle is also connected to the free ground end of the manifold Lastly, in the two receptacles five cubic centimeters of water of barium is poured. The air aspired gets rid, first of the carbonic acid, which is analyzed later, and it passes then through the iodic acid in which the *formation of a dimness of a precipitate* denotes the presence of carbon monoxide. The final operation is the analysis of the carbonate formed and the ascertaining of the quantity of iodine fixed by the barium, which is used as a means of control

Lastly, the presence or absence of most of the other possible impurities can be ascertained with the help of a mixture of solution of silver nitrate and permanganate of potassium After two liters of air passes through the bottles, the liquid must remain pink in color

With this apparatus Dr Kohn Abrest has combined a very small-sized laboratory for the analysis of industrial toxicology, and by means of which it is possible to make easily on the spot most of the chemical experiments of hygienists These sets contain bottles, re agents, vials, spectroscopes, vats and other instruments, which are placed in easily transported oak cabinets and simplify greatly the equipment necessary for making current analyses *Naturally analyses made* quickly with this instrument do not supersede completely the making of complementary verifications and researches which the experts of the laboratory should carry out with more precise scientific apparatus such, as for example, the Ogier mercury counter for fire-damp With this last apparatus, the combustion of the gases to be analyzed in air, is obtained in a glass vessel at constant temperature crossed by a platinum coil heated to incandescence by electric current. The sensitiveness of this counter for fire-damp varies between 1/2000 to 1/6000, according to the nature of the other noxious gases present.

Why Not Radio?

(*Continued from page 152*)

for a greater commercial radio service

Eleven miles southwest of Bordeaux, France, is the most powerful radio station extant Known as the Lafayette station, it was constructed by our Navy during the war for the purpose of maintaining communication with our forces in Europe, even in the event of a complete severance of cable communication. The armistice found us with the Lafayette station partly completed, and it was decided to finish the work and sell the station to the French Government as another item of our salvaging operations

The Lafayette radio station has been in commercial operation for some time, and the accompanying illustrations furnish some idea of its magnitude and excellent construction The aerial of this huge station is supported by eight steel towers, each 820 feet in height, arranged in two rows of four each, the rows being spaced 1,320 feet apart In all, the aerial system covers a plot a mile long and a quarter of a mile wide, or something like 5,227,200 square feet The arc transmitter is rated at 1,200 kilowatts, and of this something like 500 kilowatts is delivered into the antenna The range is said to be 12,500 miles under favorable conditions, or half way 'round the world.

As in the instance of several other high-power stations, the Lafayette station may be operated at a distance In fact, the business office for the station is Bordeaux, and the operators control the station by land lines. In the near future the Lafayette transmitter will probably be operated from Paris in order to offer more direct service to French traffic. As compared to the Brest-New York cable, which has a capacity of about 25 words per minute, the Lafayette radio station has a capacity of 50 words and over per minute.

The Lafayette station is not destined to remain the largest radio station for very long Already, work is well under way on what is to be known as the New York Central Station, on Long Island, near Port Jefferson, a short distance away from New York City The new station will cover 6,400 acres of land. It will have five complete transmitters, each one a duplex unit with a corresponding receiving station located near by All five transmitters and receivers will operate simultaneously

The aerial layout is decidedly a new departure From the central power house six spans of aerial wire will radiate out in a star pattern to a distance of more than one mile from the center. The wires will be supported by steel masts, each 400 feet high Each of the six antennæ will have twelve towers, or seventy-two towers in all Five of the antennæ will be used for regular service, while the sixth will be held in reserve Each transmitting antenna is to be charged by two 200-kilowatt Alexanderson high-frequency alternators The receiving units will be located eighteen miles away

Then there is the Sainte Assise station now under construction near Paris So gigantic is this station that one begins to wonder whether the French intend to maintain their present radio supremacy for all time Otherwise conservative, the French people are going to the very limit in the matter of high-power radio stations

The Sainte Assise station is located about 25 miles outside of Paris When in operation, it will have a capacity of 2,000,000 words every twenty four hours, for two-way traffic The aerial system will comprise over 130 miles of wire, and will cover some 750 acres of land This wire network will be supported by sixteen towers of about 800 feet in height The towers will be arranged in two rows of eight each, set 1,800 feet apart and extending over two miles in length

It is understood that the unit transmitter system, as already described for the New York Central Station, will be employed *in this French station That is to* say, there will be three high-frequency alternators of 500-kilowatt capacity, each being used separately to charge a separate section of the antenna, or the three can be used together for the full power. It is also understood that there will be a separate installation, with a single 800-foot tower, for handling messages over limited distances, particularly for nearby European countries The receiving stations, numbering from five to seven, will be located some distance away.

The Motor Truck and the Shoe Factory

(*Continued from page 154*)

sary constant transfer of goods between the plants

Until a little more than a year ago the company had all its hauling done by rail, then the traffic manager decided that trucks could do the work more economically and give better service Three 5-ton trucks and one 2-ton truck were put into service in November, 1918 The work these trucks accomplished in a year is decidedly interesting An executive of the company says·

"Over the 11-month period the trucks have hauled more than 11,000 tons of materials to and from Boston, at about one-half the cost of former methods, and they have improved service by about 100 per cent. When we sent out products by rail we usually got deliveries on the day after they were shipped from Brockton to Boston. With trucks we get out loads to Boston and our materials back from the factories the same day they are shipped. At a time when leather was very scarce, our buyer was hard at work picking up such small quantities as he could and sending them to Boston; and with our trucks we rushed the leather to the factories, where the need was great, on the same day it reached Boston. By rail, this would have taken a day longer. Goods for the North Adams plant are sent by trucks to Boston and then direct by rail saving a day en route.

"To haul our diversified loads, our truck bodies are built with rack sides and rear to a height of six feet. This accommodates the many cases of shoes that a truck can haul without being overloaded. One day recently one of our trucks hauled 1,000 cases of shoes, besides our regular daily shipments, to Boston for reshipment to Italy. Our 2-ton truck runs 70 miles a day between Boston and Brockton, stopping on each trip at the East Weymouth factory. Recently this truck made the 160-mile trip to North Adams in 10 hours, with capacity load much of the way over steep grades. Our trucks have been invaluable to us. *They operate economically* and they are very durable. They get there—and when factories are waiting for materials it is reliability that counts"

A New Wheatstone Bridge

A NEW Wheatstone bridge has been devised what it is said will do away with the inaccuracies of the usual bridge *is that there are no change-over switches* in the new one It retained the advantage of multiple comparative resistances and is claimed to be simpler and cheaper than the key type It is of German origin and is described briefly as follows:

The principle is the provision of several bridge circuits, *each fitted* with a button, while each of the comparative resistances is connected on one side with a terminal and fixed on the other to the measuring wire end There are thus no loose connections or movable contacts, so that the original accuracy is not affected by dirt or rough handling. As each resistance is independent, the bridge circuit is divided into three subcircuits, each with a button contact to switch-in the battery. A lead runs from the point of junction of the three bridge circuits to the right-hand battery terminal, and a lead runs from the slider contact through a 5 ohm regulating resistance to the left battery terminal The current source thus lies between the bridge circuit junction point and the slider contact. Battery or galvanometer can, of course, be used as required All other connections are as in the ordinary Wheatstone bridge. A further advantage of this instrument is that it is possible to have a measurement range with as low a resistance as 0 01 ohm.

New Process for Cracking Oils

A NEW process, details of which are being withheld from the public at present, has been evolved by the division of Engineering Technology of the United States Bureau of Mines for the cracking of heavy oils. The newly-discovered method augmented by special apparatus will render useful bulky petroleum and tars now considered unprofitable to recover as oil because of the difficulty in conveying through pipe lines or to use as fuel because of their high viscosities.

The scientific discovery as made by the Federal Government involves the cracking of these heavy oils and tars into lighter products, thereby extracting therefrom a considerable volume of gasoline and low-viscosity fuel oil. The obstacles heretofore encountered by the formation of carbon and tars, according to claims, have been surmounted, and tests of the processes on a commercial scale are recommended. *If operations of magnitude are successful,* the production of gasoline from the heavy oils and residuums gushing from the wells in California, Mexico, Texas, and elsewhere, will be possible.

IN THIS ISSUE:
WINGED TRANSPORTATION
THAT MOON ROCKET PROPOSITION

SCIENTIFIC AMERICAN

A Weekly Review of Progress in
INDUSTRY · SCIENCE · INVENTION · MECHANICS

DRILLING ROCK BY MEANS OF ENERGY TRANSMITTED THROUGH A LIQUID COLUMN.—[See page 171]

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February 26, 1921

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Price 15 Cents
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New York Life Insurance Co.

(Incorporated under the laws of the State of New York)

346 and 348 Broadway, New York, N. Y.

DARWIN P. KINGSLEY, President

Balance Sheet, January 1, 1921

ASSETS	
Real Estate	$8,407,481.00
Loans on Mortgages	164,796,225.60
Loans on Policies	147,499,247.07
Loans on Collateral	6,565,500.00
Liberty Bonds and Victory Notes	109,722,115.37
Government, State, County and Municipal Bonds	141,539,552.50
Railroad Bonds	343,293,117.30
Miscellaneous Bonds and Stock	8,416,460.10
Cash	10,574,203.04
Uncollected and Deferred Premiums	13,711,710.24
Interest and Rents due and accrued	12,087,598.25
Other Assets	51,186.72
Total	$966,664,397.19

LIABILITIES	
Policy Reserve	$759,017,704.00
Other Policy Liabilities	26,552,728.77
Premiums, Interest and Rentals prepaid	4,233,320.03
Taxes, Salaries, Rentals, Accounts, etc.	7,270,965.89
Additional Reserves	6,733,983.67
Dividends payable in 1921	37,446,654.87
Reserve for Deferred Dividends	76,176,646.00
Reserves, special or surplus funds not included above	49,232,393.96
Total	$966,664,397.19

During 1920 the Company Paid

To Beneficiaries	**$35,453,758.67**
To Living Policy-Holders	**79,395,838.63**
Total Policy Payments	**$114,849,597.30**

Dividends amounting to

$37,446,654.87

were authorized by the Directors and will be paid in 1921.

Over 200,000 new members (including former policy-holders who increased their membership) joined the Company in 1920 representing a total new business of

$693,979,400.00

The largest new membership in the history of the Company. The New York Life Insurance Company is what its name implies, A LIFE INSURANCE COMPANY. It transacts no other form of insurance. Its policies furnish the broadest coverage and provide

For payment of face amount upon due proof of death.

For payment of double the face amount in event of Accidental death.

For life income to the insured who becomes totally and permanently disabled.

There is a great opportunity in this Company for energetic, educated young men who desire to enter our business as a life work. For full particulars address either the Home Office of the Company or one of its Branch Offices.

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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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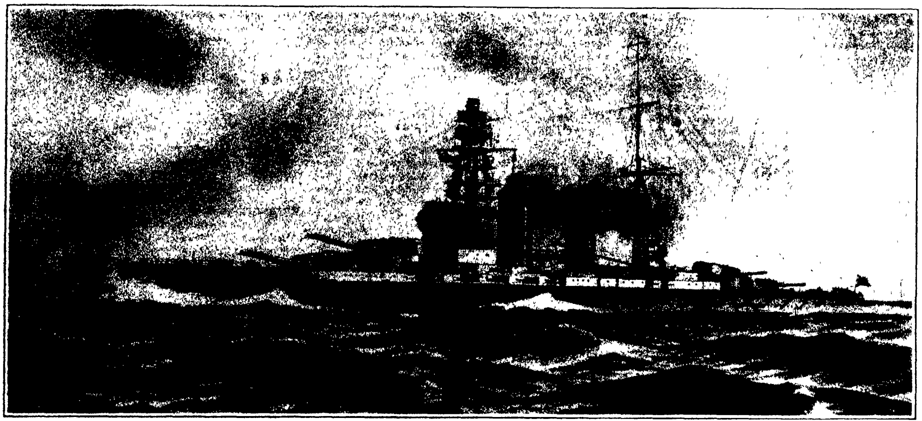

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Length: 660 ft. *Beam:* 95 ft. *Mean Draft:* 30 ft. *Displacement* 32,000-34,000 tons. *Speed.* 23 knots. *Armor Belt* 12-inch, with heavy deck armor. *Armament* eight 16-inch twenty 5 5 inch. Torpedo tubes, 8

The latest Japanese battleship "Nagato"

The Latest Japanese Battleship "Nagato"

The First Japanese Capital Ship to Include the Lessons of the Battle of Jutland

IN view of the great public interest just now in the navies of the world, particularly in regard to the proposed reduction of armaments, the accompanying wash drawing of the "Nagato," the latest Japanese battleship to be completed, possesses special interest. Although the modern battleships of all nations have reached a commonly accepted type, and are so generally similar in appearance that it takes a trained eye to recognize their individual silhouettes at a distance, the "Nagato" will be distinguishable at a glance by her remarkable five-legged foremast, with its many superposed platforms and fighting tops or, as they are now called, director stations.

The "Nagato," which was authorized in the 1916 program and laid down during the summer of 1917, was proceeded with slowly during the war and has only just been completed. She is one of a class of four ships, of which the "Mutsu" is practically completed and the "Kaga" and "Tosa" were begun in January, 1920. The four ships represent the work of Japanese designers and constructors, and the fabrication has been done in Japanese shops and yards This class of ships invites comparison with the four United States battleships of the "Maryland" class, since they are of similar tonnage and were authorized in the same year. The main armament also is the same, though the speed is higher. Not much is known about the armor plan, and it is a pretty safe guess that because of the higher speed and heavier motive power of the Japanese ships, their defensive qualities are inferior to those of the "Maryland."

The "Nagato" is 660 feet long between perpendiculars, with a beam of 95 feet and a mean draft of 30 feet. It is probable that since she was built subsequently to the Battle of Jutland the technical lessons learned in that engagement have been embodied in her construction, as they no doubt have been to a great extent in our own "Maryland" class. This means that particular attention has been paid in the submerged portion of the ship by the incorporation of anti torpedo devices, though the beam would indicate that the bulge has not been adopted The belt armor is believed to be not less than twelve inches, and the decks in the wake of the magazines have been strengthened as a protection against plunging fire

The armament is very powerful, and this is the first battleship to mount the 16-inch gun, of which the ship carries eight mounted in pairs of turrets forward and aft. The gun is a powerful piece, firing a 2,400-pound-shell with a velocity of 2,500 feet per second and a muzzle energy of 106,000 foot-tons The shell is considerably heavier than our naval shell, which weighs 2,100 pounds, but the high velocity of our naval gun of 2,800 feet per second gives it a greater muzzle energy of 112,000 foot-tons The secondary battery is also very powerful, consisting of twenty 5 5 inch guns carried in broadside on the main and spar decks The 5 5 gun is a new, long-caliber piece, coming midway in power between our own 5-inch and 6-inch guns. The "*Nagato*" carries also four 12 pounder anti-aircraft guns, and she is credited with the unusually heavy armament of eight 21-inch torpedo tubes; but we doubt that so many are carried

Japan early adopted the tubular, tripod mast first used by the British; and she seems to like it so well that she has added three more legs until we have the imposing structure which towers above her fore bridge. It consists of a large central mast about which are built four inwardly inclined legs, the whole terminating in a large fighting platform above which are the separate, enclosed director-control stations, one for the main and the other for the secondary armament A notable feature is the great number of searchlights, which are mounted upon successive platforms both on the fore and main masts and also on the after smokestack—evidence, this, of another lesson learned in the night-fighting at Jutland

In their later ships the Japanese have favored high speed, and the "Nagato" and "Mutsu" are reported to be 23 knot ships The motor power consists of turbines of 46,000 horsepower and the propellers are driven through reduction gearing, a system which seems to be giving full satisfaction in the large powers with which it has been used in the later ships of the British navy, and notably in the battle cruiser "Hood," of 165,000 horsepower

Development of Germany's Inland Waterways

GERMANY is manifesting activity in the development of its inland waterways and the traffic thereon On November 2 there was organized a new transportation company under the name of the "Neptune Transport- und Schiffarts-Aktiengesellschaft," with offices in Basel It is announced that this new concern was established through the collaboration of German, Dutch, and French shipping interests This company plans to engage in the Rhine traffic between Basel and the North Sea ports

Then, again, there is on foot a project for the canalization of the Main between Offenbach and Aschaffenburg for the use of heavy draft vessels The Bavarian Government on November 3 voted its approval of this general plan Furthermore, there was formed on November 3 in Bremen by firms, associations and individuals in that city an organization having for its purpose the procuring of a canal connection between the Rhenish-Westphalian industrial region and the deep water harbors, located on the Weser and the Elbe

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. Is a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A Navy Equal to Any Other

THE report of the Senate Naval Committee contains not a word of sympathy with the request of a war weary world to be relieved at least in some measure, of the burden of naval and military armaments under which it labors. To have recognized the widespread prevalence of its plea, which has been fully as vocal in these United States as elsewhere, would have shown that the Committee was alive to the untold miseries and sorrows of the world and was in responsive sympathy with the present attitude of American people whom it represents.

The report confines itself strictly to technical matters, and it contains three outstanding features. First, it warns the country against being carried away by exaggerated statements as to the relative value of battleships as against airplanes and submarines. With this attitude of the General Board and the Senate Naval Committee we are in most thorough accord. For the present, and probably for many a year to come, the battleship will dominate the situation.

The second outstanding feature of the report is the statement that "this country should maintain a navy at least equal to that of any other power." At one time this statement would have been fraught with danger to the peace of the world, for during the years when the German navy was looming up as a threat to the insular security of Great Britain, it was the avowed policy of that country to maintain a navy superior to that of any other power. The removal of the German peril, coupled with the feeling of comradeship and understanding which was developed by our own and the British navy during the war, has so far changed the situation that Great Britain seems willing to make an exception in the case of the navy of the United States. Certain British statesmen and naval men have indeed asserted that they would view without any misgiving the creation of a United States navy that was equal in strength to her own. It is true that in its statement that we should possess a navy equal to any other, the General Board of the Navy is announcing an entirely new policy, so far as any public utterance emanating from that Board is concerned. Be that as it may, the acceptance by Great Britain of the new standard removes any danger of international complications, and a friendly cooperation of the two navies may well prove a powerful influence for the maintenance of peace and the general security of traffic on the high seas.

So far, so good. But when we consider the third recommendation of this report, to the effect that we should continue the construction of the whole of the 1916 program, we feel it our duty to utter a strong word of protest, first, because as we showed last week, the completion of the full program would not only make our navy equal to that of any other but immeasurably stronger, and therefore we should be committed to a vast expenditure of moneys which would carry our navy far beyond the standard which is here definitely laid down by the General Board.

And this leads us to reiterate our demand on the part of the taxpayers of the United States that we complete only the four 16-inch gun battleships of the "Maryland" class and the six battle-cruisers of the "Constellation" class, and that we at once discontinue work on the six 43,000-ton battleships of the "Indiana" class and concentrate our new constructive efforts upon additional scouts, upon flotilla leaders, and upon airplane carriers, thereby rounding out our navy. This program will give us by 1924 a fleet that is not only somewhat larger in displacement and gun power than the British fleet, but one which, because of its very modern construction and its inclusion of all the lessons learned during the war, will possess a decided fighting superiority in capital ships over the British fleet, a fact which the General Board cannot deny. If we hold up the work on the six "Indianas" upon which only a mere commencement has been made, we shall still have 860,000 tons against Great Britain's 808,000 tons, and our gun energy will be 20,500,000 foot-tons against Great Britain's 19,000,000 foot-tons. Furthermore, the bulk of our fighting line will consist of thoroughly modern ships, whereas the best of the British ships, with the single exception of the "Hood," will be from eight to ten years old, and therefore will be obsolescent and outclassed. These significant truths should be embodied in this report. Why are they omitted?

These facts are not known to the average taxpayer, and unless they are clearly brought out on the floor of the Senate and the House, they will not be understood by the majority of the members of Congress. They are perfectly well known to the General Board, and they should be equally well known to the members of the Senate Committee. *In all fairness, then, to the country* whose interests have been committed in all good faith to the committees of the Senate and the House and to the members of Congress as a whole, it should be clearly stated that *the building of these six huge ships at a cost of nearly 250 million dollars will be superfluous, extravagant and a deliberate advance beyond the standard of strength definitely called for by the most experienced experts of our Navy as represented by the General Board.* The argument that to stop work on these six ships would be a wasteful extravagance is not borne out by the facts. Very little has been done, and what has been built in the way of castings for turbines and generators and motors and the laying of keel plates, will suffer no deterioration if it be allowed to rest for a while until the time is ripe for the completion of these ships.

Aqueducts Ancient and Modern

AMONG the outstanding landmarks of that dreary plain known as the Roman Compagna are the *ruins, picturesque* and dignified in their decay, of the masonry aqueducts through which the engineers of imperial Rome brought pure water from the distant hills to the city. To the casual visitor, such a monument of the past is but one among a multitude that tell of the glories of that city of a remote era. For how many of those who see and read about the aqueducts of Rome realize the positively stupendous scale upon which the hydraulic engineers of those days actually wrought? It is a fact, well attested, that Rome in the height of its magnificence received a daily supply through its fourteen aqueducts which reached a total of 400 million gallons of pure mountain water. If the mere figures fail to convey an adequate impression, let it be understood that before the opening of our Catskill aqueduct, when New York had five million inhabitants as against the maximum of one million credited to Rome, our total possible water supply, with all aqueducts going at full capacity, was less than that of imperial Rome, or, to be exact, 385 million gallons.

But why this huge expense and why this prodigality of use? Well, partly it is to be explained by the highly developed artistic taste of the Romans, who realized that a succession of fountain effects lent added grace to the architectural beauties of their public squares and their far flung colonnades. A fountain that plays throughout the day is an extravagant user of water, and Rome at its greatest and most beautiful period, when the public places of the city were graced, we are told, with some 4,000 bronzes and marbles of Grecian statuary, was enriched also with fountains in every square and well-nigh at every street crossing.

And then there were the public and private baths; for your well-found house in Rome was not complete without its bath, as the remains of wonderfully modern-looking plumbing abundantly testify. And water had to be found for the vast public baths such as those of Diocletian and Caracalla, after the main hall of which the fine waiting room of our 33rd Street station of the Pennsylvania Railroad was so faithfully modeled by the late Stanford White.

Today, thanks to our Ashokan Reservoir and the Catskill Viaduct, we have passed the standard set 2,000 years ago by Rome, and it would be possible, if we wished, to bring a daily supply of 500 million gallons through this conduit alone. Part of our present supply comes through the Croton Aqueduct, and through the Catskill Aqueduct the city is receiving 250 million gallons per day from Esopus Creek, whose waters are impounded in the Ashokan Reservoir.

Although it seems but yesterday that the new Catskill supply was opened for the use of the city, so rapid is our growth, reckoned indeed at 200,000 additional souls per year, that the city already has in hand the Schoharie Reservoir which, when completed, will double the present Catskill supply and afford another 250 million gallons daily. The waters of the Schoharie Reservoir will lie at a higher elevation than those of the Ashokan Reservoir, and they will be fed from the one to the other by means of an 18-mile tunnel driven through the intervening mountain. When the Gilboa Dam and the tunnel have been completed, the whole rainfall in the Schoharie Valley will be available for the use of this city and the great Catskill Aqueduct will be usable to its full capacity of 500 million gallons per day.

The Limits of Tidal Power

WE must be careful not to get an exaggerated impression of the available tidal power, even when the whole supply in any given district is rendered mechanically available. This is shown in a recent study by Norman Davey, published in *The Engineer*, in which the writer makes a comprehensive survey of the available tidal power as shown by the tide tables of the British Isles. We learn that at the extremity of Cornwall the mean range is about 12 feet and that as we go northward upon the west coast, it increases until a maximum mean range of 31 feet is reached at Portished from which point the value decreases until it drops to 12 feet at the Mull of Galloway. Around the rest of the west coast of Scotland it rises to between 7 and 10 feet. On the east coast of Scotland the value is still low, the average being about 11 feet. It is 10 feet in the River Humber, and at the London docks the mean tidal range is 17¼ feet.

Considering the use of bays and estuaries for the development of tidal power, particular note must be taken of the difference in the area of the surface of the water at high and low tide. Thus, the estuary of the Salcombe River in Devonshire shows a high spring tide surface area of 2.4 square miles, and a low spring tide area of only .58 square miles, and this variation is found, to greater or less degree, at all the sites. In his study of the total tidal capacity of the United Kingdom, the choice was limited by the conditions of, first, a mean tidal range of not less than 15 feet; second, a total output reduced to continuous work of not less than 10,000 horsepower, third, the avoiding of building dams outside of large seaports, and, lastly, the necessity for keeping the length of the dam within reasonable limits. In all the stations thus selected, the half-tide system working at a constant head for three hours in every twelve was adopted, and the power factor is the value of the total power output reduced to a continuous average throughout both the monthly and daily cycles.

Within these limitations it was found that 21 bays and estuaries were available, ranging from a maximum at the mouth of the Severn, with a total average horsepower, reduced to a continuous basis, of 437,000, to a minimum at Fleetwood where it is estimated that the total average horsepower works out at 18,800. The grand total of horsepower thus available, in intermittent power, but expressed as an average continuous power factor, gives a grand total of 2,263,000 horsepower.

A survey of the tidal power possibilities of the world shows that there are not many localities in which the tidal range is sufficient for profitable power development.

Naval and Merchant Marine

The Submachine Gun.—During a recent test of the submachine gun (illustrated in the SCIENTIFIC AMERICAN of October 16, 1920), by a board of officers of the United States Army, using one of the 45 caliber guns with pistol ammunition, 1,000 rounds were fired before the gun was cleaned. The gun functioned reliably and the Board reported that despite the repeated firing it did not heat sufficiently to cause trouble

An Adjustable Bow to Increase Speed.—Successful tests were recently made of a vertical hinged false bow for blunt-ended canal boats The two leaves of the bow are attached at the corners of the square-ended bow and brought together forming a wedge shaped entrance with a total angle of 110 degrees In passing through locks, or at a dock, the two wings are folded back against the front end of the barge The tests, which were carried out on the River Seine, showed that the resistance of the barges at a given speed was lowered 23 5 per cent

Why Big Submarines Are Ineffective.—In a contribution to the submarine-versus-battleship controversy, Admiral Sir H Bacon states that because of the constructional conditions attending submarine design, a craft which navigates below water loses a large per cent of her surface fighting efficiency Ton for ton, the fighting and scouting efficiency of a submersible craft of whatever size is only about 15 per cent of that of the surface vessel Sir George Owens Thurston, Naval Director of Vickers, Limited, gives figures to show that a submarine of 5,450 tons, having a surface speed of 30 knots, could mount an armament of only one 5 5 inch and one 3 inch gun

Digesting the Lessons of the War.—Recently in Parliament the Chancellor of the Exchequer stated that before approving a program of new shipbuilding, the Cabinet were bound to satisfy themselves that the lessons of the war had been definitely ascertained They had decided to charge the Committee on Imperial Defense with an exhaustive investigation into the whole question of naval power as affected by modern developments in naval warfare This will consume, it is thought, some six months It is believed that until results of this inquiry have been considered the British Government will present no program of capital ship construction to Parliament.

Shore Batteries Attack U. S. S. "Massachusetts."—Highly successful firing tests were made in January by our Coast Artillery against the old battleship "Massachusetts" off Pensacola Harbor, Florida They proved that more destructive results can be obtained by firing projectiles from guns, mortars and howitzers at high angles than by horizontal attack against the belt armor Twenty-five hits were obtained out of 85 rounds, the high angle firing being at distances of from 5,000 to 6,000 yards, carried out by 12 inch mortars The results showed that railway artillery is as accurate as the fixed gun, and this in spite of the greater length of range A number of hits were obtained by 12 inch railway guns at the great range of 20 000 yards

Merchant Marine and the Navy.—The value of a strong merchant marine as an auxiliary to the navy is beyond question No navy possesses a permanent fleet of transports and auxiliaries sufficient for its vastly extended needs in time of war To supply the deficiency it must call upon the ships of its merchant marine for transports, colliers, supply and repair ships Herein lies one powerful argument for the preservation of our new merchant fleet Furthermore, the merchant marine is the nursery for the enlisted personnel of the navy Aye, and for its commissioned officers as well, for many merchant officers performed faithful and very valuable service under temporary naval commissions during the late war

The Fluctuating History of Our Merchant Marine.—In 1789, 23.8 per cent of our overseas commerce was carried in American vessels. By 1795, the proportion had risen to 90 per cent, and it stayed with remarkable evenness at that figure until 1830. Then came the era of iron and steel ships, when we had no steel works to take the place of our splendid forests in the provision of shipbuilding material So there commenced a steady decline until by 1860 we carried only 66 2 per cent in our own ships This was the time when we commenced to extend our great railway systems and turned our efforts to developing the interior of the country, and by 1870 the percentage had fallen to 35 6, a fall which continued until in 1910 when we carried only 8 8 per cent of our overseas commerce Since that time there has been a very steady rise, helped, of course, by our war construction, until, in 1919 we carried 27 8 per cent of our overseas commerce in American bottoms

Astronomy

The Infra-Red Solar Spectrum, rendered accessible by the use of plates sensitized with dicyanin, has been photographed at Mount Wilson Observatory as far as wave length 9,900 Although the great majority of the 550 lines measured are of terrestrial origin, about 50 have been identified as solar lines through the detection of their displacements produced by the solar rotation

Edgewise Phenomena of Saturn's Rings.—Several fellows of the Royal Astronomical Society gave an account at the meeting of Dec 10, of the phenomena attending the passage of the earth through the plane of Saturn's rings on Nov 7, 1920, as observed at Greenwich Observatory with the 28-inch equatorial On Nov 6 the ring was easily visible, but no trace of it could be seen the following night A few days later, although the dark side of the rings was then turned toward the earth, the brighter regions of the ring outside the ball were seen, indicating that an appreciable amount of sunlight is able to penetrate the ring, illuminating particles on the opposite side The disappearance of the ring on Nov 7 was also observed at the Yerkes Observatory by Professor Barnard who estimated that the thickness of the rings could not exceed 40 miles

Extraordinary Radial Velocity of Two Nebulæ.—A circular from the Lowell Observatory states that observations with the nebular spectograph indicate for the nebulæ N G C, 584 and N G C 936 both evidently of the spiral family, much more rapid motion in the line of sight than has previously been observed for any celestial objects A plate exposed to the former at various times between Dec 31 and Jan 14, the total exposure being about 28 hours, shows a spectrum approximately of the solar type, in which the lines are enormously displaced toward the red, indicating a motion of 1,800 kilometers (more than 1,100 miles) a second away from our system In the case of the second nebula above mentioned the spectogram was obtained with a total exposure of 34 hours The spectrum is likewise similar to that of the sun, and provisional measurements indicate a speed of fully 1,300 kilometers (more than 800 miles) a second away from us

Sun and Moon Tables.—Beginning with the year 1917, the Naval Observatory in Washington published tables showing the time of sunrise and sunset and of moonrise and moonset for every day in the year, and for various specified latitudes The data are for the meridian of Greenwich, but the corresponding values for any other longitude are very easily computed The tables for 1917 and 1918 were published in a separate pamphlet, those for subsequent years have been incorporated in the American Ephemeris and Nautical Almanac and also in the abridged work known as the American Nautical Almanac Apparently these tables are not yet well known to the public It seems, therefore, desirable to call attention to the fact that the American Nautical Almanac, which contains a great deal of other astronomical information besides the tables mentioned can be bought from the Superintendent of Documents in Washington for the modest sum of 15 cents

New Light on Solar Variation.—The Director of the Astrophysical Observatory of the Smithsonian Institution, in his current annual report announces that an almost exact correlation has been found between the fluctuations of solar radiation, as observed at the Smithsonian station at Calama, Chile, and variations of the brightness of Saturn, as observed by Dr Guthnick from January to May, 1920, at the Berlin-Babelsberg Observatory, with the photo electric photometer One per cent increase in solar radiation was found to accompany 1 per cent increase of Saturn's brightness The variations were not, however, synchronous but occurred in such a manner as to indicate that solar radiation is unequal in different directions, as might be supposed from the ragged ray like structure of the solar corona On this hypothesis, as the sun rotates on its axis the earth or any other planet receives radiation of different intensities as rays from different parts of the solar surface strike the planet in question "This hypothesis," says Dr Abbot, "relieves us of the great difficulty of understanding how so immense a body as the sun could vary in radiation so rapidly as our observations indicate We have now only to suppose that there are inequalities of radiation in different directions, which may be due to the absorption or scattering of the rays in the coronal regions near the sun These inequalities may persist with little alteration for weeks. We, however, note them as variations of solar radiation as they sweep by us in the course of the sun's rotation on its axis "

Automobile

Light Railways Not Popular.—The Transport Act of 1919 granted the Minister of Transport of England the power to advance money for the building of light railways The plan, to the present time has not met with much favor, since out of a total of $5,000,000 appropriated by the Government not more than $1 000,000 has been demanded The commissioners in charge of the fund claim the conditions under which these governmental loans are allowed has much to do with their unpopularity, but it is the opinion of well-informed motor truck interests that the public refuses to place money in light railways for the simple reason that the motor truck has proved itself to be the logical vehicle for all short hauls in England just as they have in this country

Soldering Auto Parts—If it is desired to solder two pieces which have some thickness and bulk a good piece of work cannot be done with a soldering iron, because the parts will absorb heat faster than the iron can supply it With such work a torch must be used for sweating, heating thoroughly the parts adjacent to the intended joint and as far back as may be necessary If the surfaces are more than one-eighth to one quarter inch wide it is better to tin them before uniting This is done by spreading a smooth coat of solder over the entire surface while hot It is only necessary to press two such prepared pieces together and heat them to the proper temperature to make a perfect union This method is especially adapted to securing pipe fittings, such as nipples and unions to the copper or brass tubing serving to convey fuel and lubricating oil

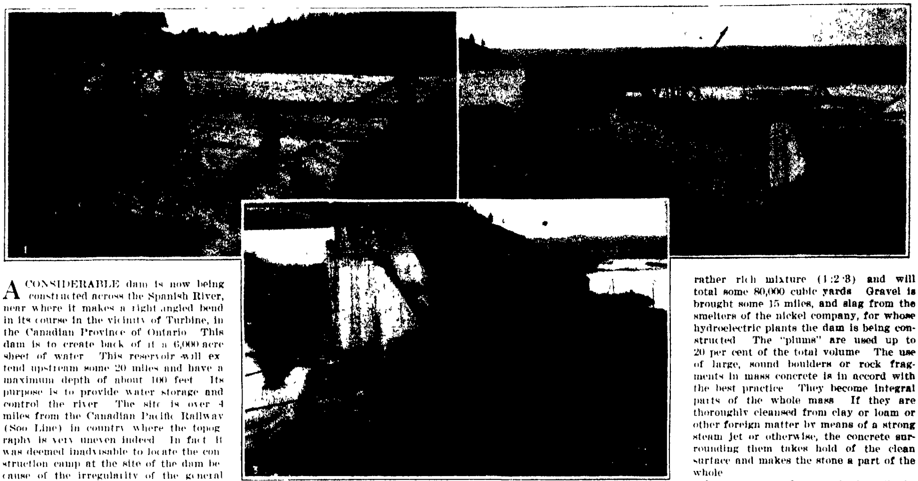
Repairing Scored Cylinders—If the automobile engine has been run at any time without adequate lubrication, one or more of the cylinders may be found to have vertical scratches running up and down the cylinder walls The depth of these will vary according to the amount of time the cylinder was without lubrication, and if the grooves are very deep the only remedy is to purchase a new member Of course if sufficient stock is available in the cylinder walls the cylinders may be rebored and new pistons which are oversize, i e, larger than standard, may be fitted Where the scratches are not deep, they may be ground out with a high speed emery wheel or lapped out if that type machine is not available Wrist pins have been known to come loose, especially when these are retained by set screws that are not properly locked, and as wrist pins are usually of hardened steel it will be evident that the sharp edge of that member can act as a cutting tool and make a pronounced groove in the cylinder Cylinders that have been damaged in this manner have sometimes been repaired by the autogenous welding process, the oxy acetylene flame being used to fuse new cast iron into the grooves, then grinding out the ridge of excess material in order to obtain a smooth bore Another patented process is to deposit some hard metal, such as nickel in the grooves by the electroplating process or use iron deposited by the same means Only the grooves are filled by this process as the remainder of the cylinder bore may be protected by some form of varnish or lacquer so the metal will not deposit except in the grooves prepared for its reception

Truck Overloading Injures Highways.—Truck overloading is disastrous to both the vehicle and the highway If its results were confined to the truck, it might be well to let each individual learn for himself that it does not pay But, unfortunately, overloading is one of the principal causes of road wear A motor truck designed to carry a certain tonnage is constructed throughout, including width of tires and safety factors to handle just its rated load Any considerable overload gives more than the standard 800 pounds per inch of tire width and concentrates the load on this small point of contact Furthermore, the overload is not distributed on all four wheels, but rests entirely on the rear axle which further concentrates the load Overloading does not materially cut down the speed and the result is that a higher rate of speed is maintained that should be given to the load, even though properly supported by adequate tire width It has been extremely noticeable in sections where the use of large capacity trucks is discouraged that there is a strong tendency to overload small trucks This is only natural, since the demand for motor hauling service remains the same and practically none can be diverted to other channels When the smaller vehicle is overloaded its effect on the road is tremendously magnified because its springs fail to function properly and the narrow bearing surfaces of its tires concentrate the impact forces so that they are greater than the road is capable of withstanding There is economy both as to road wear and as to truck operating costs in big unit loads, but not when they are carried on vehicles too small to handle them

The Big Eddy Dam

Some of the Difficulties of River Barrage in Rough Country

By J. F. Springer



1 The by-pass channel and the rail track that carried away the excavated material 2 General view of the partly finished dam from the west bank 3 Progress of construction after the site had been unwatered

Three stages in the building of the Big Eddy dam, Spanish River, Ontario

A CONSIDERABLE dam is now being constructed across the Spanish River, near where it makes a right angled bend in its course in the vicinity of Turbine, in the Canadian Province of Ontario. This dam is to create back of it a 6,000 acre sheet of water. This reservoir will extend upstream some 20 miles and have a maximum depth of about 100 feet. Its purpose is to provide water storage and control the river. The site is over 4 miles from the Canadian Pacific Railway (Soo Line) in country where the topography is very uneven indeed. In fact it was deemed inadvisable to locate the construction camp at the site of the dam because of the irregularity of the general surface. The buildings were erected on a side hill and the more considerable structures were made narrow and long in order that it might not be necessary to carry out expensive leveling operations. The irregularity of the external surface is, at the very site of the dam, well matched by the unevenness of the surface of the bed rock. An illustration of this latter unevenness occurs in the rock foundation in the mid-stream section of the river where the regulating sluices are located. The upstream face of the dam reaches very much farther down to secure its footing than does the downstream toe. But the irregularity is more complicated than this alone would indicate. The river bottom in the rock varies greatly in level as one follows the line of the dam across the stream.

The difficulties of carrying out the enterprise in the face of the foregoing character of the footing were only part of the total. The gorge through which the river here flows was by no means clean. Material from the adjacent banks and probably from points upstream covered it to a maximum depth of 30 feet. Big and little boulders and miscellaneous debris filled in the gorge and obstructed the way to the subaqueous foundation.

Under water excavation had to be carried on. Drills were operated from floats and holes put down into the fixed and loose rock to depths of 10 to 15 feet. Casing pipe would then be inserted and a proper charge of 60 per cent dynamite placed. By such means the great difficulties were reduced and the placing of cribs and caissons carried out successfully.

The dam is of the gravity type, that is, of the type that depends upon its weight to resist the pressure of the water. It is, altogether 1,100 feet long. On one side of the stream is 400 feet of bulkhead and on the other 114 feet. These are, for the most part, wings which extend from the end of the dam proper. The intervening section of dam—the dam proper—cuts across the stream in a straight line. It consists of various parts. There are spillway sections consisting of 19 openings of a standard width between partition piers of 17 feet each. In this way, 363 feet of dam is devoted to spillways. At one end of the dam proper, but separated from a spillway section by a 23½-foot trash run, is the head works. This structure is about 164 feet long and connects with a long bulkhead running off at an angle of about 45 degrees. Other features occupying length in the dam are the regulating sluices (60 feet) and a log slide.

The Spanish River has at this point a summer flow of perhaps 800 second-feet. But in the time of flood, it may be ten times as great.

Cofferdams were constructed and caissons were let down. A space was left for the river. But, in order to unwater the site in this space, a kind of by-pass channel was constructed in the rock and earth at a point about 100 feet from the eastern side. This was a considerable trench, having been 500 feet long, 25 feet wide, and 28 feet deep. The rock requiring removal totaled some 14,000 cubic yards. This material, in blasted form, had to be got out and for this purpose stiff-leg derricks were employed. It was carried away on a short service railway and piled on the bank of the stream. Later on, much of this material was employed in the body of the dam as "plums" in the concrete. The concrete is a rather rich mixture (1:2:3) and will total some 80,000 cubic yards. Gravel is brought some 15 miles, and slag from the smelters of the nickel company, for whose hydroelectric plants the dam is being constructed. The "plums" are used up to 20 per cent of the total volume. The use of large, sound boulders or rock fragments in mass concrete is in accord with the best practice. They become integral parts of the whole mass. If they are thoroughly cleansed from clay or loam or other foreign matter by means of a strong steam jet or otherwise, the concrete surrounding them takes hold of the clean surface and makes the stone a part of the whole.

Excess water due to floods will be handled by the long spillway section while the water required to operate the present power house will be controlled by three large sluiceways built through the dam. These have three valves, each weighing about 25 tons. Then each sluiceway has its metal intake tube and metal discharge tube. These two parts add, for each sluiceway, 27 tons. Erection was carried out with the aid of vertical steel rods threaded at the upper end. These carried the weights. The threaded engagement at top enabled the heavy weight to be lowered and held at exact levels pending provision for permanent support. Horizontal adjustment was secured with the aid of jacks.

A good deal of compressed air was required for operating rock drills, hoisting engines and the like and for supplying the pneumatic caissons employed at an early stage of the work. Four air compressors were put to service, all *but one being of the high pressure type*. The total capacity of the compressor plant amounted to 3,800 cubic feet of air per minute. At first, steam was used for operation, but later on electric current was substituted. The current came from the nickel company's power house at High Falls, 25 miles away. When the current arrived, it had a voltage of 35,000. A small transformer reduced this to 550 for motor use and 110 for lighting.

When one considers the big quantity of cement needed, the large valves and their connecting tubing, the steel penstock, the transformer equipment, and the various compressors, and other equipment, he is not especially surprised to learn that the contractor reconstructed 3½ miles of standard railway track connecting with the Canadian Pacific and extended it ¾ mile farther. It is, nowadays, considered quite the thing for those responsible for construction that is to be carried out in difficult country at points more or less distant from existing railways to put in their own track. The Hetch-Hetchy Railroad, built for use on the Frisco water supply project, illustrates what was done here at the Spanish River, only the California construction was on a much larger scale.

One of the 25-ton sluiceway valves

X-Ray Tests of Old Paintings

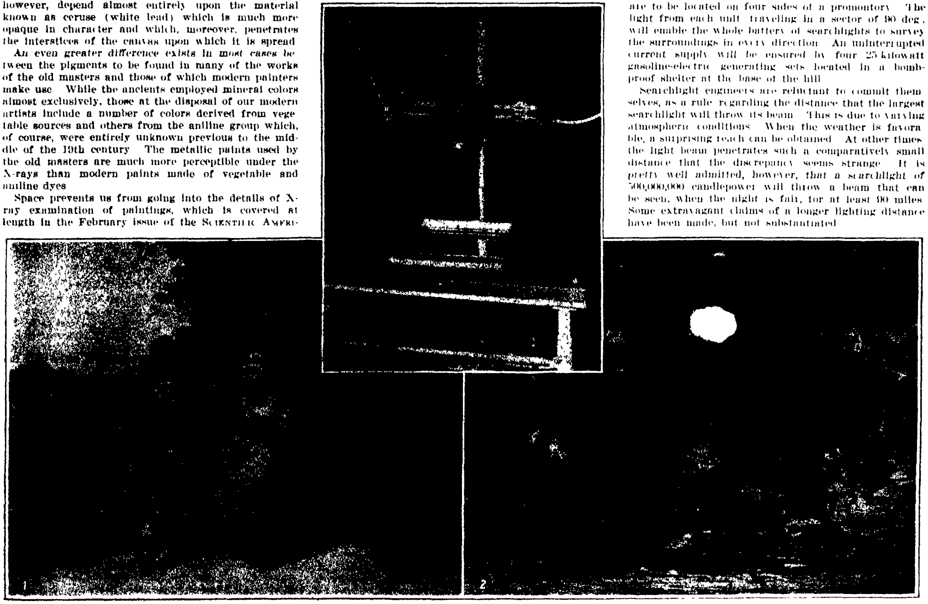
IN one of his note books Nathaniel Hawthorne relates the story of a man who, being in possession of a beautiful painting, perceived that it had been painted not upon a fresh surface but upon the top of an older painting. Inspired by curiosity and imagining, perhaps, that the older pictures might represent a greater value, he removed the upper layer of pigment to find, alas, that he had sacrificed a charming painting only to uncover a worthless daub. Had the unfortunate owner lived in this our 20th century, he need have taken no such risk, since researches recently made in several European countries show that the connoisseur now has an admirable implement in the shape of the X-ray with which to supplement his critical judgment concerning the antiquity of pictures and one revealing whether they were painted upon a virgin surface or upon one bearing a previous work of art The latest works along this line have been done by a French scientist, Dr Chéron.

The degree of transparency to X-rays exhibited by any body depends upon the number and atomic weight of the atoms composing the said body It is obvious that in every picture there are three substances to be considered from this point of view In the first place there is the surface which is painted upon, this surface is usually either canvas or wood, especially in the case of earlier paintings, however, many other materials have been experimented with by different artists at various times, including plaster, ivory, paper, leather, silk, china and pottery and even cobwebs Secondly, there is the priming or sizing which is applied to the surface to prepare it for receiving the colors. Third of course are the pigments themselves

Both wood and canvas, the principal surfaces to which oil paints are applied, are highly transparent to X-rays, but the former is more so than the latter, as might be expected The second element of the picture, the priming or sizing, is usually composed in the case of ancient pictures of carbonate of lime mixed with glue, and this composition has been found to be comparatively transparent to X-rays Modern artists, however, depend almost entirely upon the material known as ceruse (white lead) which is much more opaque in character and which, moreover, penetrates the interstices of the canvas upon which it is spread

An even greater difference exists in most cases between the pigments to be found in many of the works of the old masters and those of which modern painters make use While the ancients employed mineral colors almost exclusively, those at the disposal of our modern artists include a number of colors derived from vegetable sources and others from the aniline group which, of course, were entirely unknown previous to the middle of the 19th century The metallic paints used by the old masters are much more perceptible under the X-rays than modern paints made of vegetable and aniline dyes

Space prevents us from going into the details of X-ray examination of paintings, which is covered at length in the February issue of the SCIENTIFIC AMERICAN MONTHLY Suffice it to say here that radiographs throw a most valuable light upon the probable age of a picture, so that after devoting some study to their observation in the case of a given era, or by the hand of a known painter, the connoisseur can readily detect modern "fakes"



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Left: **Photograph of a tableau attributed to the Dutch painter Van Ostade, made in the seventeenth century** *Right* Radiograph of the same tableau, showing that it was painted in modern colors **over an old painting of a barnyard scene. Note the two peacocks in the center foreground and the ducks at the right** The white spot is a lump of wax on the back of the picture

Above: Dr. Chéron's apparatus for making X-ray pictures of paintings

How the X-ray may be used by the art connoisseur for checking up the authenticity of old masters

Java's Disappearing Searchlight

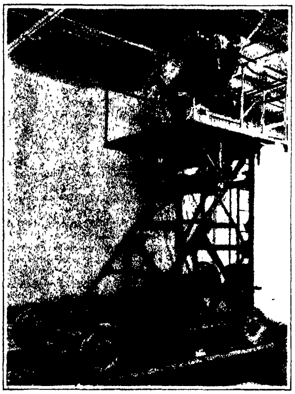
AMERICA'S mastery of coast defense problems is reflected in a certain shipment now going forward from a large American manufacturing plant to the island of Java in the far off Dutch East Indies Four *military searchlights*, ranking well among the most powerful ever built and showing several interesting variations from type are to provide the far seeing night eyes of an island seaport

The four searchlights, each rated at 300 000 000 candlepower were designed by Dutch and American engineers several years ago In fact, preliminary plans were drawn up in 1914 but the war interfered temporarily with further progress

Each searchlight carries a lens 36 inches in diameter Inside the lens case, behind the *carbons which produce* the light, is placed a powerful parabolic mirror The diameter of this mirror determines the size of the light The mirror is of great importance A superior quality of glass must be used, and the finest workmanship is necessary It must be capable of standing an intense heat and of undergoing rapid cooling It is manufactured with *innumerable tiny facets*, so that it will reflect the light rays straight out through the lens Now the light rays that originate from the carbons are thrown upon the mirror, and reflected from there through the lens on a level line The candlepower which is transmitted from the carbons to the mirror is multiplied many times when it passes out through the lens, because of the condensing effect of the optical system

The Java searchlights are, following standard practice, provided with big iris shutters which screen or expose any desired proportion of the lens This iris is made of brass scales that overlap in a rotating motion In fact, these Java searchlights like most searchlights of their style, can be controlled entirely from a distance The observer who operates the light beam can be a considerable distance away yet can throw *on or shut off the beam swing it to any* point around the sector, or raise or lower the searchlight by the mere pressing of buttons The Java searchlights are to be located on four sides of a promontory The light from each unit traveling in a sector of 90 deg., will enable the whole battery of searchlights to survey the surroundings in every direction An uninterrupted current supply will be ensured by four 25 kilowatt gasoline-electric generating sets located in a bombproof shelter at the base of the hill

Searchlight engineers are reluctant to commit themselves, as a rule regarding the distance that the largest searchlight will throw its beam This is due to varying atmospheric conditions When the weather is favorable, a surprising reach can be obtained At other times the light beam penetrates such a comparatively small distance that the discrepancy seems strange It is *pretty well admitted, however, that a searchlight of* 500,000,000 candlepower will throw a beam that can be seen, when the night is fair, for at least 90 miles Some extravagant claims of a longer lighting distance have been made, but not substantiated



Disappearing type searchlight built in this country for use in Java

That Moon Rocket Proposition

Its Proponent Says a Few Words in Refutation of Some Popular Fallacies

By R. H. Goddard

EVER since, a year ago, announcement was made that a rocket was under development which should, in principle be capable of reaching great altitudes even as great as interplanetary distances there have been numerous articles in magazines and papers of more or less authenticity.

To date, there has been little published criticism, except in an article in the November 20 *Graphic* (London). Chiefly in reply to the latter, it is believed worth while stating the purposes and possibilities of the investigation, although the writer prefers working quietly rather than issuing statements.

First, regarding the possible study of conditions at a great height in the atmosphere. Mr. Morrell in the *Graphic* article, considers it unlikely that any instruments could survive a fall from so great a height. The important point is that the instruments and rocket *fall from rest* and that under this condition even a small parachute must be sufficient to maintain the velocity at a safe value.

Thus, in the original Smithsonian publication, *Miscellaneous Collections*, Vol. 1, No. 2, p. 51, a calculation based upon the air densities that very likely hold at high elevations, shows that if instruments supported by a small parachute fall from a height of 100 miles, the velocity would be reduced to, and maintained at, a safe value even before the 20-mile level had been reached. Attention is called to the first successful sounding balloon ascension in America, at St. Louis 1904, in which instruments fell 10.4 miles without damage, *even without a parachute*.

But even if this could not be done, the suggestion made in the original paper of leaving a few charges in the rocket to be used after a considerable drop had been made, in order to check the descent, would eliminate any question as to the possibility of checking the speed.

The value of the multiple charge rocket for high altitude research is obvious when it is realized that save for a projectile fired from a gun which would produce forces too great to be withstood by a delicate apparatus this method is the only one that does not require the presence of air. Thus the record for airplanes is 6.8 miles, for sounding balloons 21.7 miles, and for pilot balloons (without instruments) 24.3 miles. As is well understood by the United States Weather Bureau, the balloon is limited to but a few miles farther, and if the region above this height is to be explored it must be by rockets of the type that has been described. Already the Bureau has suggested certain recording instruments for the purpose.

The writer has called attention to the value of simultaneous observations at the 7-mile level, from stations at considerable distances apart, as a means of obtaining a high altitude weather map for use in weather forecasting and in aviation.

Next as to the question of propulsion beyond the predominating gravitational influence of the earth the question that has given rise to most discussion is, perhaps, "What is the value of such performance even *granted that it is physically possible?*" This question suggests others. "How are you ever going to recover anything that is sent off in this way?" "How can any 'volunteer' (of which there have been 18) return?"

In reply to all these questions I wish to say first, that I have asked for no volunteers. My only previous signed statement to the Associated Press, was to the effect that there were very interesting possibilities of the method, but that the work should be put upon a substantial basis before these were discussed. While I realize the absurdity of some of the suggestions *when they are viewed in the light of what has so far been published* regarding the realization of these suggestions, I wish to say that *there are other principles just as fundamental as the multiple charge rocket principle*, which I believe can be applied concerning which experiments have already been performed in some cases, and which I further believe will lead to results of a nature sufficiently sensational to satisfy anyone.

If these matters were not to be kept confidential, at least until the work had been put upon a substantial basis, many who are either not familiar with physical principles, or who do not take the trouble to look into the matter sufficiently, would bring forward all sorts of criticisms, which would result in much talk and little actual accomplishment.

As an illustration of such criticism may be cited the comments made regarding the propulsion of a rocket in a vacuum. Experiments show conclusively that the reaction is even greater at a pressure of one fifteen hundredth normal than at the normal atmospheric pressure, yet when the first announcement of the work was made, surprise was expressed that the Smithsonian Institution could back such an absurd idea as that motion could be produced "by reaction against nothing."

In the *Graphic* article Mr. Morrell states that "bodies when they speed through the air are subject to friction against the air which is sufficient to generate tremendous heat" and that "the rocket will generate a red heat for most of the first hundred miles." This is what would happen if a high speed were maintained throughout this distance, and the air had the same density as at sea level.

As a matter of fact, in the Smithsonian publication in which the experiment is suggested the velocity is chosen at each part of the path such as to make the mass of the rocket at the start a minimum, taking into account both air resistance and gravity. This velocity *must, of necessity, be small where the air is dense*, being under 2,000 ft./sec. for the first twenty miles, at which height the pressure becomes but one per cent that at sea level. Even at a 95 mile elevation, the velocity would be but slightly over 2 miles per second, where the air has an estimated density of but four one hundred millionths that at sea level. The speed of 6.4 miles per second of which Mr. Morrell speaks as causing the rocket to "vanish in an incandescent wisp of flame and smoke" would not be supposed to be reached until an altitude of over 700 miles had been attained, at which height there must exist practically a complete vacuum. The case is entirely different from that of meteors, which enter the earth's atmosphere with an initial speed of over 8 miles per second.

Concerning next the possibility of striking the moon with a rocket granting the possibility of attaining that distance, the further comment is made that the earth and moon are moving in different directions at high speeds, the gravitational pull of the earth is complex, and there are unknown air currents. In reply to these criticisms it may be said that although the speeds of the two bodies are high and different *they are known*, with great precision, at least sufficiently well to make possible the accurate prediction of eclipses, years in advance. Also any "incalculable vagaries of air currents" above 20 miles, occur in air of practically negligible density.

Further, as the writer has already suggested, there is the obvious possibility, in using the rocket method of propulsion, of correcting the flight by transverse impulses if necessary, by the aid of photo-sensitive cells, such as the selenium or the thalofide cell, which latter increases greatly in sensitiveness at low temperatures.

In conclusion, not only does the writer believe that the multiple charge rocket principle is correct, as well as the further principles to which allusion has been made, but the experiments so far performed on the small model under test demonstrate clearly the practicability of the idea. This work is proceeding slowly because of the lack of really adequate support, although the Smithsonian Institution is doing as much as it can on a work of this kind. But although there exists the attitude that "everything is impossible until it is done," there is nevertheless widespread interest being taken in the work. To the writer's mind, the whole problem is one of the most fascinating in the field of applied physics that could be imagined.

BY WAY OF EXPLANATION

To the Editor of the SCIENTIFIC AMERICAN

I am taking the liberty of enclosing a statement which you may care to use in the SCIENTIFIC AMERICAN or the MONTHLY, which is, to a large extent, a reply to recent criticisms of the rocket method upon which I am working.

I have received a number of requests from papers for a statement of this sort, but prefer to have it appear in a publication of recognized standing.

[Signed] R. H. GODDARD.

Clark College, Worcester, Mass.
January 12, 1921

When Body Heat Affects Weighing Operations

THERE is maintained at St. Cloud, France, the International Bureau of Weights and Measures. And as is quite befitting such a bureau, the methods employed and the apparatus available for the comparison of weights and measures are accurate to a heretofore undreamt of degree. Indeed, in recognition of the work of this institution and particularly of its director, the Nobel Prize for Physics for 1920 has been awarded to M. Charles Edouard Guillaume.

Perhaps none of the features of this remarkable institution is more noteworthy than the precision balances, a description of which is included in the detailed interview with M. Guillaume, which appears in the February issue of the SCIENTIFIC AMERICAN MONTHLY. These precision balances are of great delicacy, nearly all of them being so constructed that they may be read at a distance. Insulated in glass cages supported in piers of masonry which do not touch the floor, they are employed to make comparisons of mass, especially of standard kilogram. One of them, made by Dr. Bunge, is even capable of determining weights in a vacuum.

The day before that fixed on for the experiment the observer places in the cage of the apparatus the weights needed for the next day's work. He then avoids approaching the balance lest thermic disturbances be produced by the heat of his body. Twenty four hours later, by means of one of the long metal rods which extend from the balance to the observation post, so to speak, he performs the desired weighing operation at a distance of four meters. In other words, the ingenious mechanism at his disposal enables him to place the weights upon the pans, to release the latter, etc., without coming near the scales. He watches the oscillations of the beam of the balance by means of a small telescope. A mirror firmly attached to the balance beam reflects a graduated scale whose movements made when the beam oscillates are seen by the experimenter through the telescope.

German Metal Substitutes

A GREAT deal of generalization has been indulged in on this subject, but little of definite statement or concrete detail. Any person in possession of his normal senses must know that Germany had to use other metals in place of copper, and it does not require a great deal of discrimination to infer that the metals which she would use are those which she had. But this *is far from telling us just* what she did and how she did it, or how her substitutes were made up, or how they stood the test of service. For this purpose the narrative of General Director Albert Wuerth, concluded in the SCIENTIFIC AMERICAN MONTHLY for February, from the January issue, is admirably suited.

Chemistry in Camouflage

WHEN it became necessary to distinguish between different types of green in order that various types of camouflage might be detected in photographs, the solution of the problem ultimately rested with the chemist and the physicist. It was found that so-called uviol and uranium yellow glass, such as had been made by Schott & Company in Jena, would pass a band in the red beyond the visible red and that the green in chlorophyl appeared as red through such a filter. Grass and trees when viewed through such a filter appear red, but green paint continues to appear green. With this as a starting point filters were made finally of sheets of gelatine so stained with a chemical compound as to give the same effect as had been first observed in glass with known chemical compounds.

Shall We Have a National Trade-Mark?

The Advisability of Identifying American Goods in the Markets of the World

By Ernest Townsend Williamson

THE agitation in favor of the adoption of a national trade-mark which has been carried on with varying degrees of energy for several years seems likely to gather fresh strength in the near future. It is expected that another bill providing for such a mark will soon be introduced into Congress and that business men will once more be called upon to express an opinion as to the advisability of employing some distinctive symbol or form of words to identify American goods in the markets of the world.

The growth of the idea of a national trade-mark furnishes an interesting bit of history. The notion may be said to have been "made in Germany." In 1887, it will be remembered, Great Britain passed the Merchandise Marks Act, which required, among other *things, that imported goods which as ordinarily marked* might be mistaken for British should be further identified so as to indicate the true country of origin. The Act was, by its terms at least, merely defensive, making the mark of nationality necessary only in cases where the private trade insignia tended to mislead. But Germany, compelled to stamp "Made in Germany" upon her exports to Great Britain, quickly forged the phrase into a deadly weapon of offense—with results known to all.

The startling success of the German designation, combined with the practices of the Kaiser's subjects, soon produced its natural reaction in other countries. Belief in the advantages of marking goods with some sign of their national origin developed rapidly in Europe and later took root in America. There are now in use several marks that may be described as national trade-marks, although none of them is such in the fullest sense of the term.

In France one of the first steps toward combatting the unfair use of the German designation was taken by the associations of manufacturers and merchants, such as those representing the hardware trade and the toy business, which sought to protect the products in which they were interested by means of collective marks to be used only by their members who were French and who actually manufactured in France. From these came the idea of one grand collective mark which should be owned by a union of the principal associations and serve to guarantee the French origin of the goods to which it should be applied. Accordingly, in 1915, such an organization, called *Union Nationale Inter-Syndicale*, was formed and made the custodian of a mark which should answer the purpose of a national trade-mark. This symbol consists of the word "*Unis*," made up from the initials of the corporate name, and "France," enclosed together in an ellipse. It is designed in several forms, large and small, so that a manufacturer can choose the one best adapted *to his product. The right to use it is granted only to* persons who are manufacturers on their own responsibility and who are of French birth or have been naturalized citizens of France for at least fifteen years. Companies can use it only if they are actually French, their nationality being determined by the facts of each case. The mark can be affixed only to French products, and the general rule is that an article shall be considered French if made of raw materials from France or her colonies, the fact that the finished product contains pieces or parts that cannot be obtained within the prescribed territory does not, however, disqualify it absolutely, but in each case the individual association to which the manufacturer belongs must decide whether, considering the resources of the French market, the incorporation of the foreign materials was necessary.

In Switzerland also the fear of Germany led to the adoption of a national mark. Before the close of the war it was freely predicted in Europe that Germany *would use Switzerland as a "jumping-off place" for* dumping her goods into the countries of her former enemies, and the Swiss looked to such a mark as one means of self protection. This like the French symbol belongs to a voluntary cooperative association called "*Syndicat pour l'Exportation Suisse*," and consists of the word "*Spes*" formed from the initials of that name. The right to use it is granted upon practically the same conditions as those enforced in France.

Several other countries employ marks which may be described as national trade marks in a more limited sense. Denmark has the so-called "Lur Mark" (the "lur" being an ancient form of wooden trumpet, four representations of which constitute the distinctive feature of the symbol) which the law requires to be used upon all Danish dairy products. Cuba obliges manufacturers to place certain official seals upon boxes and other receptacles containing cigars and cigarettes made in Cuba and intended for export. In Ireland the Irish Industrial Development Association controls the use of *a mark consisting of a circular device enclosing the* words "Made in Ireland" in Gaelic permitted only upon goods manufactured in Ireland and made, in general, of Irish raw materials.

The two leading commercial countries Great Britain and the United States have not yet been able to make up their minds as to the value of a national trade-mark. Discussion in both countries has occasionally waxed warm. Thus far both the British and American advocates of the adoption of such a mark have failed to carry their point. But they refuse to be silenced.

In Great Britain the agitation in favor of a British trade-mark to be applied to goods of British origin arose as far back as 1894. Later the British Empire Trade Marks Association was formed, and in 1914 this organization sought to register the British Empire Trade Mark. The project met with strong opposition on the part of powerful commercial interests. The principal argument advanced against it being that a *national mark would endanger the value of private* trade marks, and the Board of Trade refused the application on the ground that the registration would not be for the public interest.

(*Continued on page 175*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Incursive Somnipathy

To the Editor of the SCIENTIFIC AMERICAN:

Recently I witnessed a strange occurrence at Riverside Drive and 120th Street. It was mid-day and bright sunlight flooded the broad, dry expanse of asphalt. A large limousine was rolling north at fifteen miles per hour. At the rear a similar vehicle approached, moving faster.

Both cars were driven by chauffeurs, and the passengers were women. There was ample space for the second car to pass, but to my astonishment it came up behind and crashed squarely into the first machine.

It was absurd.

The second driver had sat at ease, his hands on the wheel, his gaze straight ahead. There did not seem to be anything to divert his attention.

I stepped over to where the two cars now stood. No one was hurt, simply jarred. The passengers' sensibilities were rudely irritated, one party resentful, the other nonplussed.

The second chauffeur was apologetic, admitting to the women his fault, although insisting that he could not account for his carelessness. But the first driver understood. They both understood. Superficial explanations were not for their belief.

Asleep at his wheel—sound asleep. The faulty driver was evidently a victim of incursive somnipathy. Psychology or physiology doubtless has a better term, but I do not recall it. A self-induced, yet uninvited malady, with the symptoms of which many auto drivers and engineers are more or less familiar.

The colliding chauffeur had been gazing steadily at the bright, streaming roadway flowing smoothly beneath him. Its monotonous sameness concentrated his mental faculties to the point of inducing momentary self-hypnotism.

In the field of railroading, when experienced engineers run by opposing signals, I wonder if the cause might not often be attributed to this insidious malady?

Often the charitable explanation in cases fatal to the engineer has been the possibility of heart failure or a sudden stroke causing a dead hand to hold the throttle prior to the accident. But it is possible that the effect of the unwavering stretch of twin rails blending with the even, gray right-of-way, and dissolving under the engineer's searching gaze, burnt into his brain a converging, soothing, hypnotizing desire for sleep, peaceful and potent beyond the exercise of his inhibitory will.

What might be the explanation of the series of seemingly *inexplicable and appalling accidents which oc*curred on one of our great eastern railroads a few years ago? Or of the motorman on the New York Elevated Railway, who ran by definite daylight signals with resultant fatalities? Or the taxicab driven down Broadway which suddenly left the street, crashing through a plate glass window and without warning pushing two passing men before it, injuring them seriously, while jagged daggers of broken glass pierced the driver's brain beyond the power of conscious explanation?

An acquaintance of mine who drives his own car about the city, said that he had sometimes been aroused from a sound sleep by the wheels of his car rubbing against the curb. A chauffeur told me that he saw a car waver from its course, swerve across the Drive at 78th Street, crash through the protecting chains at the edge of the walk, and finally stop down among the trees in Riverside Park. It was one of those freak happenings in which the car was not badly damaged, and the chauffeur was merely awakened from his lethargic sleep. The steering arrangement of his car was found to be all right, eliminating this mechanical feature as a possible cause of the mishap.

In many cases coming under this category, the period of mesmeric sleep may be brief, but an instant after consciousness flees, the chauffeur or engineer becomes a sinister weapon of fate. In that instant he faces oblivion and draws down the shadow of eternity upon his unsuspecting charges.

Our wonderful human personality seems to snap so easily. It goes right on trying to destroy itself through the agency of the very creations of its highly developed objective mentality. A routine gear cutter stops as the last thousandth of an inch is microscopically removed. Even an automatic-feed printing press prevents damage to itself when more than one sheet of paper tries to pass at the same time.

An automobile is said to be practically fool-proof. It almost runs itself if you can afford to buy the gasoline. Its mechanical perfection is close to realization. The most alert and constructive brains of mankind have been directed toward making it a thing of beauty, efficiency and comfort.

But the being that tries to control this modern Frankenstein is not machine made. It is not automatic. It cannot prevent its own destruction. It is human!

So far it has not been possible to synchronize the human soul with steel and iron and rubber so that our subconscious senses will operate to stop the flight of a sleep-controlled car or the sweep of an unrestrained locomotive. Yet, fanciful as it may sound, I believe it is within the scope of an Edison to harness the pulse, or register the variant blood pressure, or measure the muscular reflex, as soon as sleep takes possession of the body and by utilizing a most marvelous and delicately attuned apparatus, to cause these involuntary bodily reactions to sound a waking alarm to the driver, or actually to work in some way to automatically stop the rush of an automobile or locomotive.

Doubtless there are times when the automobile driver or engineer takes control when physically tired or under some emotional stress. Dissipation, worry and preoccupation also contribute to occasions of misjudgment and rash action. But if we can make the distinction clear enough there is food for thought in the idea *of Incursive Somnipathy existing at other times* under certain conditions, whether the victim is of normal health and habits, or due to a deflection in his coordinating powers is rendered susceptible to a favorable degree.

The idea expounded is not new to science, as early authorities have taught that by steadily gazing at any object a man can hypnotize himself without knowing it. And to make it more of a paradox, the passive symptoms would seem to manifest themselves in the case of drivers of long experience for the reason that they are no longer prone to excitement. Familiarity with a long stretch of road, or right-of-way, and the novelty of their work having passed, it becomes a matter of routine, or second nature, disarming the precautionary senses and favoring a passive condition.

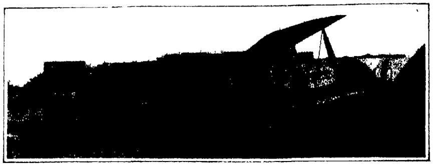
New York. DANIEL O. SKINNER.

Winged Transportation

A Survey of Commercial Air Services Both Here and Abroad

By Ladislas d'Orcy

WE have got into the habit of believing that Europe is far ahead of us in the matter of aviation. Faster machines, better climbers, more reliable engines, more unique designs, better construction, more commercial applications—all these things we credit to our friends abroad and without ever bothering to look into the status of our own aeronautical industry. It was with the idea in mind of learning just what progress has been made in commercial aviation the world over, and just where America stands in this matter, that we asked Mr. d'Orcy to study the situation and prepare an article. This he has done—and done admirably, quite living up to his reputation as an authority on international aviation. Among other things, Mr. d'Orcy brings out the surprising fact that the United States is by no means lagging behind in commercial aviation, and, if anything, is setting the pace as far as long-distance and difficult service is concerned.—THE EDITOR



One of the French cabin airplanes used on the Paris-Warsaw route

THE saying 'Distance lends enchantment,' is particularly true in respect to commercial aviation. Anyone reading foreign aeronautical magazines can easily gather the impression that Europe is simply seething with air transport activities, that any reputable firm desirous of establishing an airway is promptly subsidized by its government, that Europe is covered with commercial air lines, and so forth.

As a consequence few people realize how far American achievements have outstripped foreign accomplishments in the matter of air transport. With a view to correcting many fanciful views on this subject, an attempt is made here to present in a readable form all the essential information regarding air transport activities in the United States and abroad. This includes the air routes in operation and projected, the names of the companies operating them, the type of aircraft used and the length of every route.

A cursory examination of this information will reveal to the reader that the longest regularly operated airway in the world is the United States air mail route from Washington to San Francisco (2,484 miles), while abroad there are but two airways of over 1,000 miles' length, neither of which exceeds 1,200 miles.

One of these connects Toulouse, France, with Casablanca, Morocco, and has tri-weekly service, while the other operates in the Belgian Congo on the schedule of three trips per month. Both lines traverse territory which is ideal for flying: fogs are practically unknown in those regions, elevations are moderate if any, atmospheric conditions are, except for certain well defined seasons, remarkably even, and landing places are frequent.

On the American transcontinental air route flying conditions are far from being so favorable. Fogs are very frequent on certain sections, violent winds prevail over the Rocky Mountains and over the Alleghenies, extreme colds are encountered in the winter, and natural landing places are often few and far between. It follows that the ground organization required for making of our transcontinental air line a success involved problems far more difficult to solve than could be met on the two African routes. Furthermore, while the United States air mail operates daily, except on Sundays, the two foreign lines are under contract to run only tri-weekly and five monthly services, respectively. Taking into consideration all of these factors, it can be said without overstating the case that the United States is by far in the lead in air transport activities.

It may be objected that our transcontinental airway does not transport passengers and goods, while practically all the foreign air transport services do so. But this argument has little weight against the fundamental fact that there exists between the Atlantic and the Pacific an air route equipped with air ports, supply depots and emergency landing fields which is readily available for public air transport. That its use has so far been confined to the carriage of mails does not invalidate the fact; it merely illustrates certain local conditions.

This naturally brings up the question of the air transport subsidies. So far only France has adopted this policy, although it appears to be the consensus of opinion abroad that public air transport services will not be able to make profit or even cover expenses *for the next few years* without some sort of government assistance. It may be asked why the government should be expected to step in here and act as a godfather to the air lines instead of letting the latter flourish or perish on their own merit.

The answer to this query is that, as the next war will undoubtedly be a real first class air war, starting with bombing raids on barracks, dock yards, concentration points, railroad junctions, etc., reasons of national defense make it imperative for the United States to have a powerful air force. But as financial considerations make it impossible to maintain in times of peace the air force we will need in a war of any importance the existing air force is intended to be merely a nucleus which expands to its full force only in time of war. For this war-time expansion the air force requires two things in times of peace: manufacturing facilities and a reservoir of men versed in air navigation. But this industrial and personnel reserve can no more exist without a flourishing air transport industry than the Navy could fill its ranks without a merchant fleet. Hence it is most important that the government intervene in some manner to help in building up a merchant air fleet and in keeping it going until it can carry on without outside assistance.

That this assistance should take the form of an outright subsidy, such as the French system, is disputed by many keen observers. The French government grants a subsidy to "legally constituted air transport companies operating regular services of public utility," said subsidy being divided into four parts: (1) for maintenance and deterioration of the aircraft, (2) for non-stop distance traveled, (3) for speed maintained and useful tonnage, and (4) for military adaptability of the aircraft. The weak point of this system is that in practice it gives financial assistance to any company which keeps machines flying, while it does not pay sufficient regard to the value of the work done or the commercial utility of the aircraft employed. Furthermore the subsidizing of military adaptability openly puts a premium on military features and so tends to counteract the development of purely commercial—and therefore profitable—machines.

The British government, on the other hand, provides only indirect assistance to air transport firms in that it assumes responsibility for the organization of air ports, the wireless and weather services and research and experimental work. Clear thinking Englishmen begin to realize, however, that this assistance is not sufficient to enable their air transport enterprises to "carry on" during the period in which converted war material is being used up. In this respect it is significant that the British Advisory Committee for Civil Aviation in its recently issued report went on record as favoring a scheme of air transport subsidy that would grant financial assistance in proportion to service rendered.

Other countries, like Poland and Czecho-Slovakia, grant subsidies in the form of a lump sum per mail flight on approved routes.

In this country Government assistance entered the field last fall, when the Post Office Department contracted with several air transport companies for the carrying of mails on approved routes and schedules. This system, which essentially consists in paying a given sum for a given service, is undoubtedly sound in principle. Still, it is open to criticism insofar as it excludes competition and so does not encourage performance beyond that strictly necessary to fulfil the terms of the contract. Nevertheless, such as it is, our mail contract system is at least as good as, if not better than, the foreign system of subsidy already mentioned.

Below there is given a tabulation of the world's air transport services as far as information is available. The services listed include those actually in operation as well as those for which contracts have been awarded by the respective governments. It should be noted that all foreign air transport services are privately owned and operated and that almost all carry passengers, although some do not carry mails. All the French air lines listed are subsidized, the services to Prague and Warsaw being also subsidized by the Czecho-Slovak and Polish governments, while the Malaga to Casablanca line also draws a subsidy from the Spanish government.

The German air transport services, which are subsidized in some form by the German government, operate on more or less irregular schedules, owing chiefly to the scarcity of gasoline. It is possible that service on some of the routes listed has been suspended until next spring.

No recent information is at hand regarding the Colombian and Far Eastern air transport companies and the information is merely given for the sake of completeness.

THE WORLD'S AIR TRANSPORT SERVICES

United States

(A) Government Owned and Operated Services

(The United States is the only country in the world to have a government owned and operated air transport service.)

U. S. Air Mail Service, Post Office Department, Washington, D. C.

Routes: (1) Washington-New York (218 miles). Daily, except Sundays.

(2) New York-Cleveland-Chicago-Omaha-Cheyenne-Salt Lake-Reno-San Francisco (2,266 miles). Daily, except Sundays.

(3) St. Paul-Chicago-St. Louis (610 miles). Daily, except Sundays.

Fleet: Forty DH-4M (400 hp. Liberty). Mail load, 400 lb.

Twenty Twin DH (two 200 hp. Liberty). Mail load, 600 lb.

Seventeen Curtiss R-4-LM (400 hp. Liberty). Mail load, 400 lb.

Seven Curtiss JN-4H (150 hp. Wright). Mail load, 200 lb.

Seven Curtiss-Standard J-1 (150 hp. Wright). Mail load, 200 lb.

Five Junkers, JL 6 (240 hp. B.M.W.). Mail load, 1,000 lb.

Three G. L. Martin (two 400 hp. Liberty). Mail load, 1,500 lb.

Two Curtiss HA. (400 hp. Liberty). Mail load, 800 lb.

One L.W.F. (240 hp. Isotta-Fraschini). Mail load, 800 lb.

Delivery of twelve DH 4M and forty-nine L.W.F. mail airplanes is pending.

(B) Privately Owned and Operated Services

Aeromarine West Indies Airways, Inc., New York.

Route: Key West-Havana (106 miles). Daily, except Sundays.

Fleet: Six F-5-L (two 350 hp. Liberty) cabin flying boats. Mail load, 500 lb. Passenger capacity, 11. Carry U. S. mails.

Hubbard Air Transport Company, Seattle, Wash.

Route: Seattle-Victoria, B. C. (84 miles). Ten trips per month.

Fleet: Boeing seaplanes and flying boats. Carry U. S. mails.

Aero Limited, New York.

Route: Miami-Bimini-Nassau, B W.I. (200 miles). Irregular.

Fleet: F-5-L (two 350 hp Liberty) and HS-2L (350 hp Liberty) flying boats. Passenger capacity, twelve and six, respectively.

America Trans-Oceanic Company New York

Route: Miami-Bimini-Nassau, B W I (200 miles). Irregular.

Fleet· Curtiss H-16 (two 350 hp Liberty), HS-2L (350 hp. Liberty), Curtiss Seagull (150 hp Curtiss), and Curtiss MF (90 hp. Curtiss) flying boats

Lawson Airline Company. Chicago

This company is under contract with the U S Post Office Department to carry mails on a daily schedule on the following routes

(1) New York Harrisburg-Pittsburgh-Fort Wayne-Chicago (785 miles)

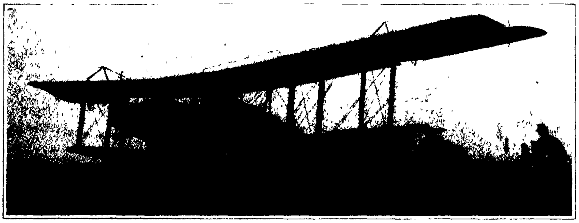
(2) Pittsburgh-Columbus-Cincinnati Indianapolis-St Louis (600 miles)

(3) New York-Washington-Raleigh-Columbia-Atlanta (815 miles).

A fleet of three-engined cabin airplanes having a mail capacity of 1,500 lb and accommodations for sixteen passengers is under construction Service on route 1 is to start next spring.

Mercury Aviation Company Hollywood, Cal.

This company, which for the last year has been operating irregular air transport services in southern California, proposes to establish next spring a regular passenger air line between Los Angeles and San Francisco (340 miles)



Handley-Page cabin airplane at a London airport, about to start for Paris

France

Compagnie Générale Transaérienne. Paris

Route Paris-London (223 miles) Tri-weekly.

Fleet Nieuport cabin airplanes

Compagnie des Messageries Aériennes Paris

Routes (1) Paris-London (223 miles) Tri-weekly.

(2) Paris-Brussels (155 miles) Tri weekly

(3) Oran-Casablanca (450 miles) To open next spring

Fleet. Bréguet 320 hp and 450 hp, cabin airplanes

Compagnie des Grands Express Aériens Paris

Routes (1) Paris-London (223 miles) Bi-weekly

(2) Paris-Brussels (155 miles) Trips to be made tri-weekly

Fleet Farman Goliath (two 260 hp Salmson) airplanes

Compagnie Franco-Roumaine de Navigation Aérienne, Paris.

Routes. (1) Paris-Strasbourg-Prague-Warsaw (875 miles). Tri-weekly

(2) Paris Strasbourg-Vienna-Belgrade Bucharest - Constantinople (1,600 miles) To open next spring.

Fleet· Potez S E A (320 hp Lorraine).

Société "Aéro-Transport" Paris

Route Paris-Geneva (280 miles) Five trips per month.

Fleet. Salmson (260 hp) airplanes.

Fokker cabin airplane used on the London-Amsterdam air transport service

Compagnie Française des Courriers Aériens Atlantique-Méditerranée. Toulouse

Routes (1) Toulouse-Bordeaux (130 miles). Four weekly

(2) Toulouse-Montpelier-Marseille-Nice (380 miles) Four-weekly.

Fleet: Salmson (260 hp.) airplanes.

Lignes Aériennes Latécoère Toulouse.

Routes: (1) Toulouse-Barcelona-Alicante-Malaga-Tangier-Casablanca (1,170 miles). Tri-weekly

(2) Malaga-Tangier-Rabat-Casablanca (250 miles). Five-weekly

(3) Paris-Bordeaux-Madrid-Lisbon (1,000 miles). To open next spring.

Fleet: Salmson (260 hp.) airplanes are used on routes 1 and 2; Farman Goliath (two 260 hp. Salmson) airplanes are to be used on route 3.

Compagnie Franco-Bilbaine de Transports Aéronautiques. Bordeaux.

Route Bordeaux Bayonne-Bilbao-Santander Gijon (330 miles) Tri weekly Only the section Bayonne-Bilbao is in operation

Fleet Lévy (300 hp Renault) and Tellier (200 hp Hispano) flying boats

Compagnie Aérienne Française Paris

Route Nimes-Nice (130 miles) Bi weekly

Fleet A R (190 hp Renault) airplanes

"L'Aeronavale," Société Maritime de Transports Aériens Marseille

Route Marseille Port Mahon Algiers (470 miles) To open next spring

Fleet Flore cabin flying boats

Compagnie Transaérienne de l'Est Strasbourg

Routes to be opened next spring

(1) Strasbourg Brussels Antwerp (250 miles)

(2) Strasbourg Frankfort a M (120 miles)

(3) Strasbourg Zurich (90 miles)

Great Britain

Air Post of Banks, Lt London

Routes London-Paris (223 miles) Bi-weekly

Fleet Westland 5-passenger airplanes (300 hp Hispano-Suiza)

This route is to be extended next spring to Bordeaux, Madrid and Lisbon in conjunction with the Latecoere Line of Paris

Air Transport and Travel, Ltd (Airco Line) London

Routes London-Paris (223 miles) Two trips daily

Fleet Airco-18 8-passenger airplanes (450 hp Napier) Airco-16 4 passenger airplanes (360 hp Rolls-Royce), Airco 9 2 passenger airplanes (360 hp Rolls Royce)

Handley-Page Transport, Ltd London

Routes (1) London-Paris (223 miles) Daily

(2) London-Brussels (210 miles). Daily

(3) London-Amsterdam (259 miles) Daily, temporarily suspended

Fleet· Handley-Page W 8 14-passenger and Handley Page O-410 10-passenger airplanes for routes 1 and 2, Airco 9 and Airco-4 2 passenger airplanes for route 3

Instone Air Line. London

Routes· London-Paris (223 miles) Irregular

Fleet Vickers-Vimy 12 passenger and Airco-9 2-passenger airplanes.

Belgium

Syndicat National pour l'Etude des Transports Aériens ("Sneta Line") Brussels

Routes: (1) Brussels-Paris (155 miles) Tri-weekly

(2) Brussels-London (210 miles) Tri-weekly.

(3) "King Albert Air Line" Kinshasa-Stanleyville Belgian Congo (1,125 miles) Three trips to be made monthly

Fleet Bréguet, DH 9, DH-4 and Salmson 2-passenger airplanes are operated on routes 1 and 2, Lévy (300 hp Renault) flying boats are used on route 3

Routes 1 and 2 will have daily service by next spring

Holland

Koninklijke Luchtvaart Maatschappij (K L M Line) Amsterdam

Routes (1) Amsterdam London (259 miles) Daily

(2) Amsterdam-Bremen (170 miles) Daily

Fleet Fokker F II 5 passenger airplanes (185 hp B M W)

Germany

Deutsche Luftreederei Berlin

Routes

(1) Berlin-Leipzig-Nuremberg Munich (330 miles)

(2) Berlin Swinemunde (110 miles)

(3) Berlin-Leipzig Frankfort a M (270 miles)

(4) Danzig-Memel-Riga (320 miles) To open next summer

Fleet A E G, Albatros and Rumpler airplanes

Lloyd Luftverkehr Sablatnig Berlin

Routes

(1) Berlin-Bremen (195 miles)

(2) Bremen Hamburg Copenhagen (240 miles)

(3) Bremen-Hamburg Warnemunde-Malmoe (200 miles)

(4) Bremen Gelsenkirchen Frankfort-Munich (450 miles)

(5) Bremen-Amsterdam (170 miles)

Fleet Sablatnig (260 hp Mercedes) cabin airplanes

Denmark

Danske Luftfahrtselskab Copenhagen

Routes (1) Copenhagen Hamburg Bremen (240 miles)

(2) Copenhagen Malmoe Warnemunde (120 miles) These services have been suspended until the opening of spring

Norway

Norsk Luftfartrederi Kristiania

Routes

(1) Stavanger-Haugesund-Bergen (120 miles) Daily

(2) Kristiania Kristiansand (200 miles)

Fleet Supermarine flying boats for route 1, Dornier (260 hp Mercedes) flying boats for route 2

Service on these routes has been suspended until next spring

Portugal and Colonies

Macao Aerial Transport Company Macao

Routes

(1) Macao-Hongkong Canton (150 miles)

(2) Hongkong Swatow-Amoy Foochow Shanghai (1 100 miles) Projected

Fleet. Curtiss H 16 and HS 2L flying boats

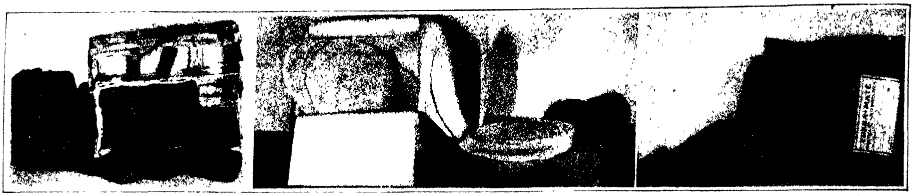
Colombia

Compania Colombiana de Navegacion aerea Medellin

Routes Baranquilla Medellin (400 miles) Irregular

Fleet Farman Goliath 14-passenger airplanes (two 260 hp Salmson)

The foregoing catalogue of air services is, of course subject to change from day to day Indeed, since it has been compiled there may be several additions and some changes, since air transport is more or less a day-to-day affair and must remain so for some time to come This is the first time that such a compilation has been undertaken It is a basis for future compilations



Left Panocha bar- and tablet-sugar of South America, imported in many forms *Center* Cassava hard-tack bread disks, with the jumbo walnuts of Chile, ranging six inches in girth. *Right* Yerba maté from Paraguay

Tea-table items from south of Panama

Latin Foods in Old New York

Something Familiar for the Native of Any Quarter of the New World

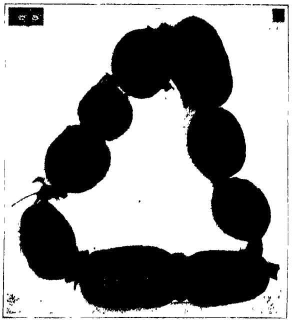
By L. Lodian

FROM the tortillas and tamales of Mexico and Venezuela, the sun-dried meats of Uruguay and Argentina, the dried bananas of Central America the yerba maté of Paraguay and Brazil, to the cassava bread of Colombia and Ecuador the crude-sugar cones of Peru and Cuba, the choice nuts of Bolivia and Chile—such are but a few of the foodstuffs of Latin America currently obtainable in New York City There are more diverse South American edibles on daily sale in old Gotham than will be found in any city of the continent to the south of us Nor is this surprising

A newspaper directory for 1920 lists more technical and class journals printed in Spanish within the boundaries of Manhattan than will be found in Buenos Ayres or Rio de Janeiro These of course are chiefly concerned with the export business—or supposed to be There are in particular a number of very creditable house organs printed in Spanish for circulation through the southern republics Manhattan has also a Hispano American Institute the like of which exists in no other city of the new hemisphere, or even of Spain itself In this metropolis of the new world will be found a greater variety of nationalities from the southern republics than anywhere south of the Rio Grande Due to the presence of these people it is that there are imported to New York the various foodstuffs characteristic of each of the Latin countries Obviously if we can buy in New York the major elements of the dietary of each of our southern neighbors the totality of foreign products thus offered will be much greater than in one of the southern republics itself, which does not cater particularly to the tastes of visitors from the other side of the Andes Of the many featureful and representative comestibles from the Latin table which the writer has purchased in the stores of New York, a few of the most striking are illustrated here

Your Latin American must have his black coffee in small cups, sweetened with the crude panocha sugar The difficulty, when he is sojourning abroad, consists in getting the sugar This serves a triple purpose It helps clarify the coffee, it of course sweetens the drink, and it imparts a certain smooth semi-syrupy gusto to the beverage which seemingly only the Latin knows how to relish The illustration shows this sugar in bar form as imported in curious woven one-kilogram containers of wood shavings a box de luxe for the peon These are retailed at about half a dollar here in the countries of their origin they bring about one-third as much The slab form is also obtainable at the leading import houses but is less convenient for breaking up Then there are the quaint little crude sugar canes weighing one kilogram each also the irregular chunks that result from loose packing in barrels, followed by a settling of the mass into a rock-like whole which can be dissociated only by the pick-axe

Another sugar obtainable in New York—if one is wise and lucky—is the palm product of the western coast A recent consignment in 300-pound barrels at eighteen cents was taken up as soon as announced This is the only palm sugar of the western hemisphere, and is a most delectable sugar of honeyed fragrance The color is sandy, whereas the palm sugar of India and other Asiatic parts and the Nile Region is a brownish black of exquisite sweetness It too is obtainable in New York and a few other American cities that harbor oriental stores



The morcilla of Latin America, a pork product preservable for years

The recent scandalous price of sugar and the gluttony for sweets seen in the enormous candy consumption have a moral the use of table sugars should be prohibited in the manufacture of confections Meantime those hard pressed to get any sugar at all might remember that in the Latin American and other exotic colonies of Manhattan they can always get a little brown sugar of delectable flavor The Arabic colonies have their raisin-, palm, date-, karob-, manit, and imfi-sugars, the Japanese and Chinese their own particular versions, the Greeks their currant sugar. Some of these, despite the long journey which they must make to reach the exiles whose demand creates the supply in America, are retailed at a lower figure than the granulated product from Cuba During the last three years of recurrent sugar famine, the writer was never without sugar, though never hoarding it, he was always able to purchase a little among one or another of the Spanish American or diverse other alien colonies of Manhattan

The morcilla is a sustaining pork product from the south which can be kept for years, becoming very hard on the outside yet softening up somewhat after paring off the rind These parings, by the way go into the stew pot or soup pot The morcilla is ideal as a sustaining food for mountain travel, due to its fat content, it is probably the most heating meat product extant It is put up in various forms—in bologna shape in ball form, or in huge bladders which a man can scarcely lift It is eaten just as it is, having been already doubly steam-cooked and subjected to prolonged smoking, or it can be served reheated, which develops the flavor appreciably

Voyagers versed in travel-craft, and in need of a temporary makeshift drinking cup, are wont to scoop out the meat from a morcilla ball and use the skin as a vessel Ground coffee or maté is put in, boiling water poured on, and all is merry The heat wrinkles the membrane slightly, but it can be used about a score of times before it actually ruptures

While familiar enough among the Latins of Manhattan, the South American tea known as yerba-maté (*Ilex paraguayensis*) has made slow progress as a beverage with Americans, although on sale in some local stores for the past three or four decades. It is a product of Paraguay and Brazil—that from the former country being in best repute among connoisseurs It occurs in commerce as a finely comminuted leaf, and in the cup or pot, after adding boiling water, the tiny leaf flakes float for a couple of minutes exactly remi-

(*Continued on page 177*)

Left Sun-dried unsalted strip-beef from the Plata; always dry and clean to handle. *Center:* Maté from Brazil, the label shows the native way of sipping it through a tube from a gourd. *Right:* The unbroken shell is a Brazil-nut pod; the other is the sapucaia nut from the upper Amazon

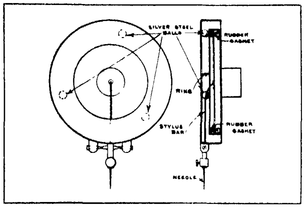
Food and drink from Brazil and her neighbors

A Phonograph That Is Always at Its Best

By R. G. Skerrett

NOTWITHSTANDING the much that has been done since the inception of the phonograph to make it capable of more fully and exactly interpreting the timbre and tone of the human voice and divers musical instruments, the results have been but partway successful Not only has the phonographic reproduction lacked in the case of some instruments the distinctive characteristics that are theirs, but choruses and orchestrations have not been caught by the recording device so that they might be rendered as we are accustomed to hear them Finally, the enunciation of the speaker and the singer has become muffled or indistinct through the processes of mechanical preparation of the records and their subsequent audible interpretation Now, however, a very notable advance has been made in the art, thanks to the labors of Philo E Remington, of the third generation of that family which has achieved a conspicuous position by reason of the fruits of its inventive cunning

One of the reasons why the run of the reproducers on our phonographs do not fulfill the expectations of their makers is because the sound waves have not the opportunity, owing to the character of the diaphragm mounting, to acquire their full amplitude In short, these waves, vital to faithful interpretation of the original source of sound, are more or less deformed or modified by the limiting facilities provided for the propagation of recording or reproducing vibrations Mr Remington has perfected a highly sensitive and elastically mounted diaphragm and has furnished at the same time, a vibratory field, so to speak, that gives the sound waves full or undampened play In this way, individuality of tone is assured, even though there may be many of these seeking to reach the ear



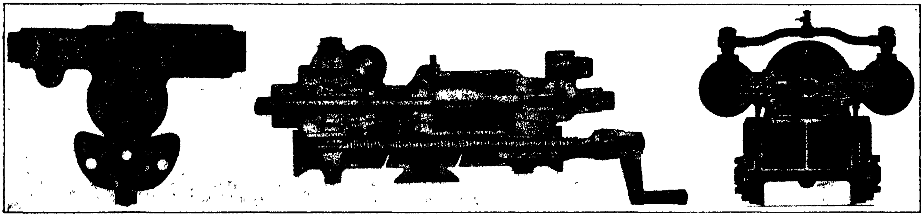
Details of the diaphragm suspension that makes a single reproducer give best results for all tones

Mr Remington's phonographic reproducer is really an evolution of an ingenious loud-speaking telephone transmitter conceived and patented by Captain D H Wilson, a naturalized citizen of this country, a few years ago The basic feature of the pioneer idea originating with Wilson was the use of numerous steel balls, arranged in two similar circles placed, respectively, above and below at the edge of the diaphragm His construction made it feasible to insure an equal pressure on the diaphragm at all points of support and, at the same time, to permit the disk to vibrate freely Mr Remington became associated with Captain Wilson during the latter's experiments, and immediately realized how the phonograph could be benefited if the same principles were adapted to that instrument

He promptly determined that the thing for him to do was to mount his phonograph reproducer in its own metallic case and then, in turn, to mount this on a series of ball bearings held within an outer case -the purpose being that the inner feature should rest as it were, upon sustaining needle points provided for that purpose both at the front and the rear So far, so good, but extensive research was needful to settle upon some of the vital details In this quest for the most desirable bearing agencies, he tried out balls of various sizes and different numbers—using miniature spheres of glass, silver, steel, etc Finally, he fixed upon three silver steel balls, a quarter of an inch in diameter, symmetrically placed upon one side of the diaphragm and between it and the outer casing of the reproducer

These balls are separated from the diaphragm by a metal ring which rests on a rubber gasket. This adoption of the 3-point contact, in combination with the insulating properties of the method of support employed, makes it practicable to keep the diaphragm in place under a uniform pressure applied around its entire edge, and yet permits the mica disk that freedom of vibration which is required to enable it to respond and to transmit the tone waves resulting from any movement of the needle, no matter how slight Here we find one of the difficulties surmounted which has previously hampered the faithful reproduction of a high soprano voice or any other tone source inducing short wave lengths Many phonograph reproducers are so designed that it becomes well-nigh a physical impossibility in assembling them to hold the diaphragm in a way so that they will vibrate evenly throughout their surfaces

In the Remington reproducing device the insulating quality of the minute points of contact with the steel balls prevents what is termed, in musical parlance "over-tones" The reason for this is that the tonal values of the reproduction are sent through the tone arm instead of being largely transmitted from the exterior side of the reproducer through the mass of that arm In brief, the sound waves are carried through the conduit furnished by the hollow tone arm and, accordingly, follow the line of least resistance on to the tone-chamber of the instrument whence they issue to the auditor Both the tone arm and the tone-chamber are also sustained by 3 point supports and, therefore, they vibrate with an unusual degree of freedom



Right: Section of a wave generator developing 10 horsepower, taken through the spherical reservoirs that maintain the supply of fluid and equalize the forces on the crankshaft *Center:* Longitudinal section of a rock drill operated by wave power *Left* A section through the mechanism that revolves the drill steel

The apparatus for driving rock drills by power transmitted by pressure waves through a pipe of water

Power Transmission by Fluid Waves

BRITISH *contemporaries are having a good deal to* say, just now, about the application to peaceful purposes of the fluid-pressure system of power transmission, developed out of the invention of M Constantinescu of a leverless and gearless means of synchronizing the trigger of a machine gun with the blades of the airplane propeller, so that the gun might shoot between the revolving blades

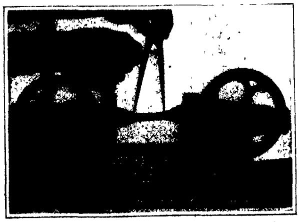
In a sense the rather extravagant claims of a brand-new mechanical principle are justified, though we strongly suspect that the physicist, had he been appealed to, would have insisted with equal force that the principle was covered by pre existing knowledge We are in the habit of thinking of water as absolutely non-compressible but we must realize that the fact is a little away from this that when we apply pressure to this or any other fluid, there must be some reduction of bulk If there were absolutely no compression in a column of water a blow delivered at one end of the column could have but one effect—the delivery, instantaneously at the other end of the column of a blow of identical force Even the rupture of the containing pipe at some intermediate point would appear out of the question, were the fluid absolutely lacking in compressibility

The Constantinescu system now being commercialized by a leading firm of British engineers, works through the fact that this compressibility exists The pipe line is filled full, and blows struck the fluid at one end These blows, instead of being delivered instantaneously through a rigid column cause compression waves, as they are called, to traverse the pipe with a perfectly definite velocity approximately that of sound in water (4 800 feet per second) The actual motion of the water under the influence of these waves is a slight oscillation forward and back as the successive impulses arrive at a given point and pass it by The obvious analogy is with the ordinary speaking tube, in which the air does not actually flow through the tube, but in which it does act as medium for the transmission of the sound waves At the receiving end the wave impulses are picked up by a plunger which is caused to reciprocate And that is all there is to it, outside of the strictly engineering problems of proper design of the wave-producing apparatus and proper connection with the machine in which the power is ultimately to be used

This machine to date has usually been a rock drill, or in some cases a riveting hammer Here the plunger is used in simple fashion as a floating piston and strikes a blow directly on the shank end of the drill steel or rivet snap Flexibility in use is gained by means of a steel tubing of rather extraordinary character, which *can be coiled up in a roll tight enough to be carried* over the shoulder, but which presents joints that are entirely tight to the water oil, or whatever other fluid may be employed Coal cutting and pile-driving equipment operated in this manner is also to be had A more complete account of the new system appeared in a recent issue of the SCIENTIFIC AMERICAN MONTHLY

How Much Will It Stretch?

THE average layman doubtless has heard the expression 'tensile strength' and realizes that this forms the object of many tests, but he probably has a wholly false idea of just what is involved He doubtless pictures the material under test being subjected to greater and greater strain until it is actually pulled apart with the amount of pull necessary to achieve this end the sole numerical result of interest The fact is, that even more than in the ultimate breaking point technicians are interested in the amount of stretch which a given material will show under moderate strains, of the sort to which it may with some probability be frequently exposed Our picture shows a sample of leather being carefully tested for stretch in this fashion, and we may remark that before it leaves the jaws of the little machine, it will be measured also for 'reduction in sectional area"



Testing leather to see how far it will stretch under a given pull

With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

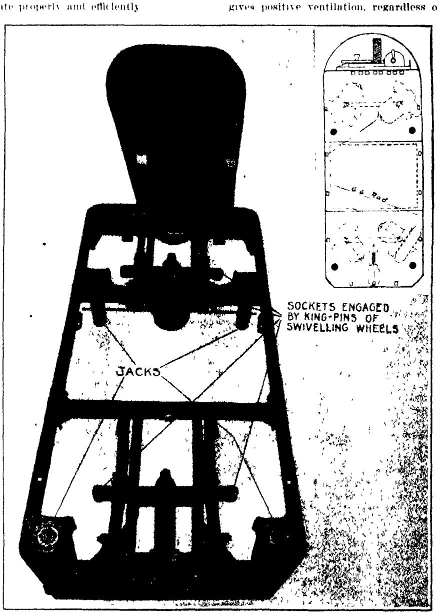
A wheelbarrow type loading platform during loading operations

Combined Street and Warehouse Truck

THE underlying motive of much of the inventive effort of the present time is the urgent necessity for reducing labor costs. This holds true not alone of manufacture as carried on in our factories but of various means of transportation of the raw materials and the finished product as they move, let us say, from mine to factory, from factory to warehouse and from warehouse to consumer. Unquestionably, the greatest element in transportation costs is that due to handling and rehandling, and the production of any new form of crane, elevator truck or motor truck that will cut down the handling costs is sure of a ready welcome, if it proves to be efficient and durable.

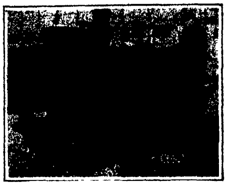
We present illustrations of a new form of truck which possesses the unique advantage that it can be loaded on any part of a warehouse floor, run under its own power to the elevator, and when it reaches the street, instead of transferring its burden to a larger motor truck, has been so designed that it can carry its own load through the streets and deliver it at store front, freight yard or steamship pier. A standard truck of this type will have a platform 4½ feet in width by 8 to 10 feet in length, the floor of the truck being about 2 feet above the ground. Its maximum capacity is about 5,000 pounds, its speed over a street or road with fairly good surface is from ½ to 10 miles per hour in a light condition, and from ½ to 7 miles per hour under full load.

Since one of the chief objects of the design is to get rid of hand trucking by enabling the truck to be run up to its load on the warehouse floor, it was necessary to obtain a very short turning radius. Mr. W. C. Brinton, who developed this truck, provided each of the four wheels with its own motor and mounted the unit, as thus assembled, upon its own independent vertical king-pin, as shown in the accompanying plan view. Our illustration shows the relative positions of the wheels when the truck is moving around a post or column, on a 6 foot 6 inch radius. To cut down the standing time of the trucks, a number of four-legged platforms are provided, mounted either upon a pair of wheels at one end or upon four castors, upon which the material is loaded independently of the trucks. The underside of the loading platforms is of sufficient height to allow the trucks to be run in beneath them. The platform is lifted clear of the ground by means of four screw jacks, one at each corner of the platform, the nuts on the jack are operated by means of sprockets on an endless chain which engages all of them and is driven by a motor which is controlled by the driver of the truck. By this means the platform is lifted clear of the ground for transport by the truck. The wheels have rubber tires of exceptional thickness, and in spite of their relatively small size no difficulty is found in traversing streets and roadways that are in any decent kind of repair.



Chassis of the truck showing the springs and sockets for the independent, motor-driven wheels, and the four jacks which raise the loading platforms clear of the ground. The insert is a plan view showing the independent, motor-driven wheels, in their relative positions when turning a sharp corner, such as moving around a post or column

Chassis and mechanism of the new electric truck



Loading platform, picked up by truck for transportation

Speaking of Ventilation

IN any room containing a considerable number of persons, the air is continually having its temperature raised and its relative humidity increased, by radiation and evaporation from the bodies and respiratory apparatus of the persons themselves. The oxygen is also being absorbed and the carbon dioxide content increased and volatile toxic emanations from the bodies of the individuals present are tending to accumulate. It is plain, therefore, that the air in the workroom must be regulated in some intelligent way, if the human machinery that is housed there is to operate properly and efficiently.

Ventilation meets this requirement by changing the air in the room—removing the vitiated air and supplying pure, fresh air to take its place. There is always a certain amount of interchange going on between the inside and outside air, through leaks around doors and windows, and often in other ways, but this natural means of ventilation is usually inadequate, and when it does furnish a satisfactory amount of air, the system (if we may call it by such a name) is usually objectionable on the ground that it produces draft. Open windows are also objectionable for the same reason. Furthermore, it is usually necessary to close them in wet and cold weather.

An artificial ventilating system may operate by blowing fresh air into the room, or it may draw the vitiated air out by means of an exhaust fan. In the latter case, fresh air, entering through the doors and windows, or through specially provided inlets, will take the place of that which is withdrawn. A blower system, continues an authority in *The Travelers Standard*, has the following good features: (1) It gives positive ventilation, regardless of the prevailing outside atmospheric conditions, (2) the air leakage is mostly outward, so that the rooms are practically free from drafts and are more uniformly ventilated, and (3) the system can be readily changed to meet unusual requirements or conditions. There are objections to such a system, however, (1) because its work is rendered inefficient, especially in cold weather, if too many windows are opened (though this is also true of other artificial systems), and (2) the cost of installation and operation may be considerable. These objections are largely offset, however, by the great advantage accruing to the employees and the employer, as already explained.

An exhaust or extraction system of ventilation is less costly to operate, because the vitiated air can be passed into stacks, where, by reason of its temperature being higher than that of the surrounding air, it will create a draft and help quite materially in keeping up the necessary circulation. The main disadvantage of the exhaust system lies in the lack of control over the supply of incoming air. A cheap extraction system, which is satisfactory in many cases, can be provided in a one-story building by the use of pipe ventilators extending through the roof to the outside. These pipes should be capped with cowls. Boards inclined at an angle of about 45 deg. should be provided at the top and bottom of the windows in the rooms, so that the incoming air will be deflected upward, thereby preventing drafts. As the outside conditions vary, the window openings may be regulated to supply the proper amount of air. A common fault with a system of this kind is that the pipes and cowls are often too small. For a room of 50,000 cubic feet capacity, the ventilating pipe should have a cowl at least two or three feet in diameter, to insure proper ventilation.

The best ventilating system is a combination of the forced and exhaust methods. Inlets supplying fresh air should be placed near the upper parts of the rooms, and outlets should be provided where they will insure a complete circulation of the pure air before it is removed. Under ordinary conditions, it is best to locate the outlets at or near the floor level, on the same side of the room as the pure air inlets. The incoming air should be propelled by fans through channels that can be cleaned easily, and the system should be constructed so that the air supply can be regulated to meet the requirements of both temperature and quantity.

A Helicopter for Military Purposes

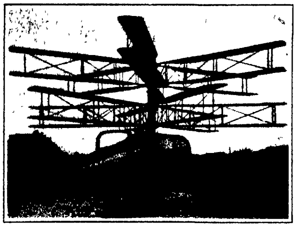
THERE was recently held at Barcelona, Spain, the first official trials of the helicopter invented by Pescara, an Argentine of Italian descent, for the benefit of a French military commission. This commission, which included the famous flier, de Romanet, made the following significant report regarding the Pescara helicopter:

"We have found Pescara's helicopter admirably constructed and we are certain that we shall be able to carry out all the tests intended and necessary with such a machine. All those which we have made gave us the full measure of force we expected. It is with the greatest assurance that we will continue the experiments, but we do not wish yet to try any definite flight tests. These will probably take place next month.

"What we can now state is that the construction of the helicopter is so good that it may be stated that the present machine gives promise of much greater chances of success than any that have been hitherto designed."

The Pescara helicopter follows the well-known scheme of two huge lifting propellers revolving in opposite directions about the same axis. The body of this machine is very much like a racing automobile, with the engine and radiator at the front end, and a tapered streamline rear. It is provided with a stout landing chassis. Mounted on this body is a vertical mast which carries the two horizontal or lifting propellers. Each propeller comprises six spokes which carry wings of biplane design. These wings are reinforced and wired so as to make the entire structure quite rigid. The propellers revolve at 200 revolutions per minute.

By means of a lever the operator of the new helicopter can tilt the mast and the propellers to any desired degree, causing anything from a direct upward flight to a horizontal flight. Furthermore, the operator can control the direction of rotation of the propellers, even to the extent of having one work against the other so as to make for a braking action. In this manner, so the inventor claims, it is possible to make very slow landings devoid of any danger, even when alighting on rough terrain. While in the event of engine failure there is admittedly insufficient wing surface to prevent a sharp drop, Pescara claims he has worked out a system of wing control which he says checks the speed of the descent.

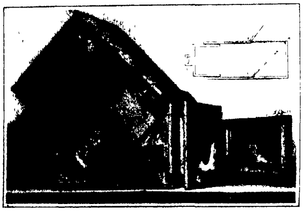


The Pescara helicopter which was recently tested by a French military commission

Finding Present-Day Uses for the Forerunner of Our Cameras

THE camera of today traces its lineage back to the middle of the sixteenth century, when an Italian philosopher, Battista Porta, exhibited his *camera obscura* to the crowds that flocked to his house in Naples. The Porta apparatus in its more developed state consisted of a pair of telescoping boxes as shown in the accompanying sketch, one containing the lens *O*, which could be moved back and forth for focusing purposes, a mirror inclined at 45 deg., *MM*, a piece of ground glass *MV*, placed in the shadow of the screen *TT*. The light entering through the lens was reflected by the mirror on to the ground glass. Or, if it was necessary to make a sketch of the image, a piece of paper was substituted for the ground glass.

Of course, with such a simple arrangement the image was reversed. Now to make the image as it should be, all that is necessary is a mirror mounted in front of the lens, as shown in the photograph, and inclined at 45 deg. This mirror can be mounted on a wooden frame and so hinged that it can be folded down when the apparatus is not in use. A further improvement on the Porta *camera obscura* is to provide a hood of the type shown, which can also be folded down when the apparatus is not in use. All in all, this improved model may be readily built by the average handyman, and it serves to study landscapes, engineering works, buildings and other objects on a small scale. If desired such objects may be traced on paper. The *camera obscura* even at this late date may come in for no end of useful tasks such as aiding the draftsman and the artist in reproducing any scene or object on drafting board or canvas.



Improved Porta camera obscura for studying scenes and objects, and (in insert) diagrammatic layout of original apparatus

Oxygen Testing of Steel

IN a new publication of the Bureau of Standards, Scientific Paper No. 350, "Equilibrium Conditions in the System Carbon, Iron Oxide, and Hydrogen in Relation to the Ledebur Method for Oxygen in Steel," is shown that mixtures of iron oxide and Acheson graphite are not, and mixtures of iron oxide with "cemented" iron or white iron (annealed or unannealed) are reduced at 900° C by the carbon in them when hydrogen is passed over them at rates of 2 liters per hour or faster. Because of these facts it is probably impossible to determine by the Ledebur Method more than 75 per cent of the oxygen present in steels as ferrous oxide. The effect of rate of passage of hydrogen on the Ledebur oxygen content of certain steels is shown. This paper is now ready for distribution and any one interested may obtain a copy by addressing a request to the Bureau.

More Products for Cold Storage

AN extension in the scope of cold storage is occurring. It is not in time during which preserved products are held. Investigations into the number of years cold storage would "keep" turkeys, for example, proved naturally unpopular with the consumer. The *new investigations have been commendable and concern* themselves with new products suitable for the process—fresh fruits, principally. Cold storage is of economic benefit when it takes surplus eggs in spring and carries them over to late fall and winter, when egg production is never adequate to consumption. It similarly is of economic benefit when it saves surplus fruits for out of season consumption.

A cold storage enterprise at Kansas City has carried its work with fresh fruits along to a commercial basis. Strawberries and other berries, cherries, plums, and tomatoes, have been kept frozen for six to eight months, and taken out, have been declared fresh and full-flavored. One of the large bakeries had in this cold storage plant $20,000 worth of cherries which are now on the market.

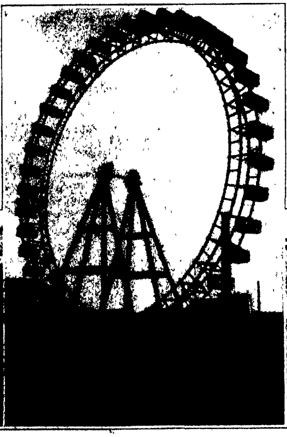
The use of cold storage for such perishable fruits and berries logically follows up the pre-cooling investigations which have been successful in this country and Canada. Reducing the temperature of such perishables before shipment adds hundreds of miles to the distance they can be shipped, and results in improved condition on arrival.

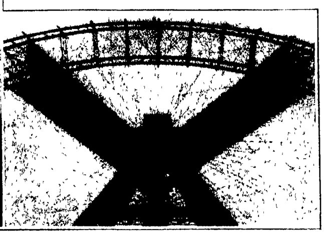
As pre-cooling somewhat mitigates the formerly insuperable handicaps of the grower having ripe perishables to market, so cold storage for out-of-season consumption is more aid to him. There are obvious market-stabilizing possibilities in cold storage for strawberries for example. It is a safe conjecture that these possibilities will in due time be exploited. The housewife ultimately—who knows?—may be able to can fruits almost any season in the year.

Taking Down the Giant Ferris Wheel of Paris

IN the recent past there have been two worthwhile attractions in Paris for the tourists in search of big things, namely, the Eiffel Tower and the giant wheel. But today the latter, which has been proclaimed unsafe and a serious menace by the powers that be, is being taken down, piece by piece.

"La Grand Roue," as it is called, was completed in 1899 and opened to the public during the exposition of 1900. It measured 325 feet in diameter and was of remarkably light construction. Since then it has offered entertainment to tens of thousands of visitors to Paris, commanding, as it does, an excellent panorama of Paris. By last October, however, the authorities decided that the wheel was no longer safe, and they stopped its operation. More recently the owners of the wheel, finding no further use for their property in its usual shape, decided to dismantle it and to convert the cars and steel and cables into spot cash. And it is just as well, perhaps, for Ferris wheels have long since outlived their usefulness.





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Left: Cars or cabins of the big wheel, which are now going to serve as huts for the inhabitants of the devastated regions. *Center:* "La Grand Roue" at the height of its glory, in 1900, during the Paris Exposition. *Right:* Looking up at the scaffolding and framework erected by the wreckers for facilitating the dismantling of the great wheel

How Paris is taking down its huge Ferris wheel, which afforded pleasure to visitors for twenty years

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Simple re-railers applied to standard railroad rails by a wrecking crew

A Re-Railer for the Wrecking Crew

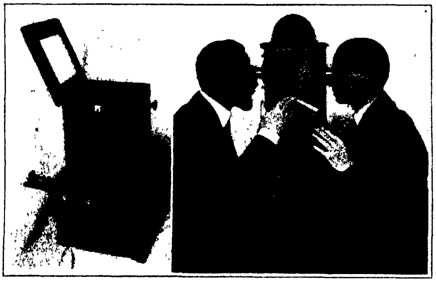
RAILROAD wrecking crews work by the minute rather than by the hour. That is to say, they must do their work as rapidly as possible, and minutes count heavily against them for every minute lost on a leading railroad line represents a serious inconvenience.

In this connection it is interesting to note the simple re-railer invented by A. Freed of Quakertown, Pa., and depicted in the accompanying illustration. This re-railer consists of a single steel member which is fastened to the rail in the manner shown. Two re-railers are used, of course, one for each rail of the track. The shape of the sloping part of the re-railer is such that it engages the wheels of the rolling stock which is being pulled back on the track. The flanged wheels are carried up clear over the rails and then fall a short distance into their normal place.

The Two-Man Stereoscope

FROM France comes the two-man stereoscope or an apparatus that permits two persons to see the same stereoscopic view at the same time. This device which is the invention of Dr. Andre Cheron gives new life to the stereoscopic picture especially for instructional purposes.

Briefly, the new stereoscope follows the general lines of the European models, so far as external appearance goes. However, it is provided with two pairs of eyepieces instead of one and the light is placed at the top of the case. Now the essential characteristic comprises two clear glass plates which are arranged on either side of the stereoscopic slide at an angle of 45 deg. The stereoscopic slide, which is a transparency, is held vertically. Arranged horizontally back of each glass plate is a black screen, preferably made of black velvet. The light which falls on these glass plates from the light above is partly reflected back at right angles, passing through the transparent stereoscopic view, through the clear glass plate on the other side, and into the eyepieces opposite. The black velvet serves to absorb the rays which come through the transparent plates, so that the observer does not see the glass plate on his side through which pass the rays of the image. All the metal parts must be painted a dead black to avoid reflections. Obviously, the observers cannot both see the image in the same way, since one of them sees it reversed, but this appears to be a small disadvantage.



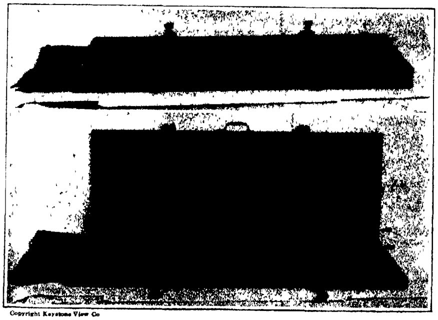
Two-man stereoscope, showing it opened to indicate the position of eyepieces, inclined glass plate and black velvet screen, as well as in use

Turning the Switch to Press the Trousers

THE great problem of every man who takes pride in his personal appearance is to keep the crease in his trousers. This means frequent trips to the tailor, or the frequent manipulation of the family iron. There are certain presses and stretchers which are said to put a crease in trousers left in them overnight but these devices generally presuppose that a crease already exists in the trousers and they merely serve to accentuate the crease.

From France comes the electric trouser press which is said to solve the trouser crease problem for the fastidious dresser. The press, which is shown in the accompanying illustrations, opens up so as to permit the trousers to be carefully laid out. Special recesses are provided for the pockets. The press is then closed and electric current applied. After fifteen minutes the trousers are ready to be taken out and worn, with just as sharp a crease as if they had been handled by a skilled pants presser. No damp cloth or sprinkling is necessary with this device. The inventor explains that the latent moisture which is always present in cloth is sufficient, in combination with the electric heat applied, to make the crease.

The device consists of nothing more than electric heating units faced with an asbestos cloth and held in a two-part press, as shown. About 600 watts of electricity is necessary.



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Electrically-operated trouser press for the home, shown in the act of pressing and open at the end of the operation

What Happens to the Box When Slings Are Used to Unload a Ship

TWENTY boxes frequently constitute a sling load in transferring cargoes from ships to lighters. The weak point of many export boxes is the crushing of the top and bottom edges of the boxes due to the pressure of the slings, according to tests recently begun by the U. S. Forest Products Laboratory. The weight of the contents of the boxes when added to the weight of the container itself causes a heavy lateral pressure to be exerted by sling ropes and chains against the top and bottom edges of the outer layer of boxes.

Buying Pulp Wood by Weight

WORK done at the Forest Products Laboratory, in cooperation with the News Print Service Bureau, to obtain data on buying and using pulpwood on the weight basis indicates that such procedure would be very desirable. If such a thing proves possible the uncertainty as to the actual solid cubical content of the present cord would be eliminated and allowing for the percentage rot in wood by scaling would partly be done away with. Buying pulp-wood on the weight basis has the further desirable features that the industry could establish a sensible and rational cost accounting system and it will also be a decided stimulus to a more thorough technical control of all of the mill operations. The disadvantages, however, are that the seller of wood will have to be educated to this method of purchase, and at the present time since there is an actual shortage of pulpwood the mills will have to purchase according to the method desired by the seller.

A New Metallic Packing

WE are shown an interesting new packing material, of which the component elements are mica and babbitt metal. The patentee, B. W. Goodsell, an old designer of packings, has perfected the method of incorporating mica flour inseparably into the metal, as a part thereof, and has been able to achieve this result in plastic, twist and slab forms. He claims a double service as the result of this—100 per cent greater durability than by the use of the agencies generally employed as lubricants.

The plastic packing has as its base a granulated babbitt, into which is milled a new adhesive holding compound, and short bits of metal wire as the binding agent. While this combination is being hot milled, the mica is distributed evenly throughout the mass. The result is a packing, suited for all engine room and marine service, according to the claims of the maker, and which he characterizes as to all intents and purposes of all-metal composition. It is equally suitable for rods, valves, rotary motors, etc., and as the material never fuses, it can be removed and reused.

The twist packing is a second style, designed specially for automobile, truck and tractor pumps, where limited space generally obtains. In addition to the convenience of applying it, it is claimed that the packing is an absolute rust preventer on idle machines. The twist is composed of skeins of soft metal wires drawn to 007 inch diameter, spread, wax-filled mica-treated, then folded, compressed and twisted into the required sizes.

Shall We Have a National Trade-mark?

(Continued from page 167)

In this country, it will be remembered, the adoption of a national trade-mark began to be seriously urged soon after the outbreak of hostilities in Europe, when everyone was painting rosy pictures of the future of our export trade. The designation of American goods by a special symbol was regarded in many quarters as one of the most effective means of enhancing the reputation of our products abroad and of retaining the markets to be won

The bill providing for a national trade-mark introduced in Congress in 1916 however, failed to pass, and that brought forward in 1918 met a similar fate The latter was objected to especially because it would have made the right to use the national mark dependent upon licenses to be granted by the Secretary of Commerce The effect of such an arrangement, opponents of the measure declared, would be to place the export trade of the country practically in the hands of one man What form of legislation will now be proposed remains to be seen.

But if we are to have a national trade mark, what, precisely, is the purpose that we should make it serve? All of those who favor the adoption of a national mark of some kind would not answer this question in the same way Most business men who have studied the problem intelligently would probably say that a national trade-mark should be used simply to indicate that the goods upon which it should appear were of American origin But representatives of the Bureau of Foreign and Domestic Commerce and some others have insisted that a national mark ought to stand as a guaranty by the government that the goods bearing it are up to a certain standard or that they are actually as described by the manufacturer The difficulties of enforcing standards of quality for goods to be sent abroad and of checking up the honesty of exporters are obvious In countries like France and Switzerland the situation is different there the private associations controlling the use of the so-called national marks can exercise over their members a supervision wholly impossible for the government with respect to the exporters of the entire United States, and the fact that the volume of trade is comparatively small tends to simplify the problem If we do adopt a national mark, it seems clear that we should not try to make it anything more than an indication that the goods on which it appears are made in the United States

Those opposed to a national trade mark of any kind contend, however, that, no matter what our own understanding might be abroad, the mark would inevitably be regarded as much more than a simple designation of origin. The average foreign buyer, they say, could hardly fail to take it as an assurance of high quality, and upon finding some marked goods below standard, as must often happen, since manufacturers of inferior articles would be especially anxious to use the mark, he would become prejudiced against American products in general

Another argument vigorously pressed by opponents of the project as a whole, here as in Great Britain, is that the use of a national mark would gradually undermine the value of private trade-marks. Since both would appear together upon a given article, the presence of the official designation, it is declared, would of necessity detract from the importance of the private symbol in the eyes of the foreign consumer, who would ultimately come to identify the product by the former. Owners of old-established marks that have won high reputations in foreign markets urge this point very strongly, fearing that the use of a national mark

(Continued on page 177)

Plan Your New Factory NOW

YOUR vision of the future—a factory airy, light, pleasant to work in, a maker of good-will as well as profit—you can plan it now, and GET it.

While the lull in building lasts, your executives and factory heads have time to analyze your needs and your architect has time to do them justice

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We can be of service to you regarding daylighting and natural ventilation. As specialists in the manufacture of sash with exceptional ventilating capabilities, we have developed some unusual and strikingly effective ways of using them. Wider floor areas, better layouts, better visibility of work and improved health conditions are secured by utilizing our experience. Not merely the sash and its operation, but the general design of the building, are often involved We may be able to show you how to get a *better* factory, foundry, or mill than that of your vision—and at less cost.

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Shall we send literature?

Booklets on Lupton Service

We have published four booklets showing examples of Lupton Service applied respectively to (1) machine shops, (2) foundries, forge shops and other heat-producing buildings; (3) general manufacturing buildings, (4) power houses Copies will be sent free to any business executive, architect or engineer on request. State what types of building interest you

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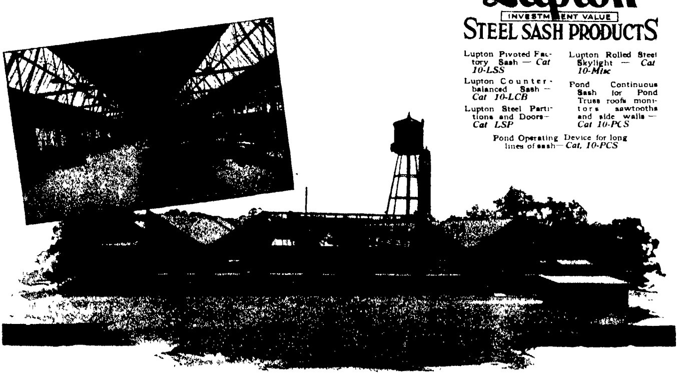
Pond Continuous Sash for Pond Truss roofs monitors sawtooths and side walls — *Cat 10-PCS*

Pond Operating Device for long lines of sash— *Cat, 10-PCS*



National Pneumatic Co Rahway, N J Conrad F Neff, Architect Pond Continuous Sash used in all roof openings Lupton Pivoted Factory Sash in walls

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

FLYING MACHINE.—C Orseri, P O Box 32, Belmont, Mass The invention relates to a machine of the helicopter type The object of the invention is to construct a machine which is not primarily designed with a view to traveling at great velocity, but which shall be capable of safely rising and descending in a vertical plane and capable of transporting passengers and merchandise without relying on an extremely high power, light type of motive power

Electrical Devices

ELECTRIC LIGHT FIXTURE.—G F Villarel, 1052 University Ave, New York, N Y An object of this invention is to provide an electric light fixture which is capable of a wide variation in design ornamentation and coloring, which will distribute and diffuse the light so as to give the desired illumination in all directions and yet overcome glare *A further object is to provide an attractive* effect at a reasonably low price

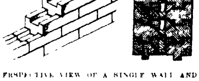
TELEPHONE RECEIVER.—J C Kane, 421 Crawford Ave, Detroit, Mich This invention relates to telephone receivers of the character especially adapted for 'radio' work, wherein a diaphragm is provided balanced in the magnetic field between the pole pieces, to reduce the stress and permit the use of a very thin steel diaphragm and a very powerful magnetic field

Of Interest to Farmers

HAY RAKE.—W Kouns Salina Kans Among the objects of this invention is to provide a hay rake in the form of an attachment which may be used in connection with any form of motor vehicle such as a motor truck for the varied line of purposes to which rakes are put on the farm and in agricultural activities A further purpose is to provide an attachment which may be easily connected or removed

Of General Interest

WALL CONSTRUCTION.—E H Kleinfelder, 29 Bradhurst Ave, New York, N Y. An object of the invention is to provide a building block of such construction that it may be correctly *easily, and quickly laid to form* a strong and durable wall of neat and attractive appearance without requiring the exercise of skill on the part of the mason, thereby presenting labor saving features and *reducing to a minimum any waste of building* material The block can be made for use in either single or double walls



A PERSPECTIVE VIEW OF A SINGLE WALL AND A SECTION OF DOUBLE WALL

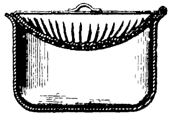
STIRRING AND DIPPING DEVICE.—E *and G Kent, address C E Phenicie* 111 E 34th St, Tacoma, Wash The invention relates to a stirring and dipping device particularly *adapted for stirring and dipping from* receptacles containing milk and cream and the object is to provide in a single device *means for performing both operations* A further object is to provide of this character, which is strong and durable, and which may be manufactured and sold at a low price

HAIR WAVER.—P A Alberghini, *address* Florence Case, 309 W 47th St, New York, N Y The invention has for a specific object *to provide a waver in which the hair receiving* members are placed in position against the head and the hair arranged thereon before the heating elements are applied so that the proper adjustment of the hair may be secured to produce a substantially natural wave in a minimum time without injury to the hair

FIREPROOF CABINET.—R R Imhoff, 281 Jackson Ave, Jersey City, N J This invention has particular reference to devices intended primarily, though not entirely, for the storage of inflammable materials such as sheets of celluloid Among the objects is to provide a fireproof cabinet with double walls and intervening air space to reduce the liability of ignition of any inflammable material *within the cabinet, by reason of fire or flame* on the outside of the cabinet or spread of flame from within

ALLOY.—J Milliken, corner William and John Sts, New York, N Y The object of the invention is to provide an alloy more especially designed as a high temperature metal *and being especially adapted for use in form*ing apparatus used in handling and casting glass The alloy consists of the following *ingredients in approximately the following* proportions iron 8 12 per cent, copper 55 65 per cent nickel 12 18 per cent, zinc 11 17 per *cent and silicon about ½ to 1 per cent*

FRUIT STRAINER.—V Plughoff, Box 87, Huntington, Oregon The invention relates to strainers adapted for use in straining juices for making jelly and jam, the purpose being the provision of a strainer which is adapted to be used in conjunction with a cooking vessel whereby the fruit may be strained directly into the vessel thus eliminating the *necessity of removing the juices to some other* vessel for a final cooking



A VERTICAL SECTION OF THE STRAINER AND A COOKING VESSEL

WALL RESISTING THRUST OF EARTH AND WATER.—J Lacaze Calle Naiper 671, Buenos Aires, Argentina *The purpose of the* invention is the saving of building material in the construction of walls designed to resist by *their own weight the horizontal thrust of the* earth or of water according to the invention such walls are erected by casting shaped walls *of pure or reinforced concrete,* in which the weight of the filling serves to substitute the weight lacking in the wall for assuring the *stability of the same*

COMB.—O R Altwein, Asheville N C The invention relates particularly to combs designed for straightening short kinky hair, *an object being to provide a comb having a* hair of stationary parallel tooth members and between said members provide a movable tooth *member with means for moving the same* longitudinally to regulate the distance between the faces of the teeth so that any *desired grip may be had,* hence, when the comb is heated, the kinky hair will be straightened out as the comb is moved through it

AUTOMATIC VENTILATING DEVICE FOR WATER CLOSETS.—A J Gritton c/o Sanatorium Worthington, Minn An object of the invention is to provide a device by means of *which the bowls of water closets may be ven*tilated rendering them more sanitary A further object is to provide a system by means *of which a fan is automatically set into opera*tion while the closet is being used, and to prevent a back flow of the gases while the device is not in use

Machines and Mechanical Devices

PRINTING ATTACHMENT FOR PHOTO PRINTING MACHINES.—T G Cooper, 1101 Ashley St, Jefferson City, Mo Among the *objects of the invention* is to provide a printing attachment for photoprinting machines arranged to automatically print identification characters and other legends on the back of the sensitized printing sheets during the printing thereof, with a view to identify the prints of each particular job, also to print the photographer's name on each print

ENGINE DRIVING CONNECTION.—F H Simonton, 412 Audubon Ave, New York, N Y *Among the objects of this invention is to pro*vide in an engine drive connection utilizing the direct force of a reciprocating power member, *a means which will permit the said reciprocat*ing motion to be translated directly into a rotary motion without the use of small spring *actuated members,* thus eliminating the necessity for use of a crank shaft and a connecting rod as usually employed

COAL LOADING DEVICE.—R. T. McKeen, 1501 E. 64th St, Chicago, Ill. *The object* of the invention is to provide a device by means of which coal may be economically *loaded into cars at the mines* The device is primarily intended for use in coal mines using the room and pillar system and in which *the coal is gotten out by under cutting* with a chain machine A further object is to provide a form of shovel which may be operated by power in a room having a relatively small height

Musical Devices

TONE ARM BASE.—A R Spicacci, 788 *Lemott St, West Hoboken, N J* The invention relates to talking machines, and particularly to a tone arm base which is simple and comparatively cheap to *manufacture* Another object is to provide a base and tone arm construction to permit a free turning movement, while at the same time presenting a mechanical construction which will not readily get out of order and will wear for a long time

PIANO TOOL.—R C Bishop, 1080 E 10th St, Ada Okla The invention relates to a tool used in the repair and regulation of piano actions, the object being the provision of such a tool which, although adaptable to innumerable uses in repairing and regulating piano actions, is especially designed for softening the felt of piano hammers and giving the correct shape at the striking point, thereby improving the tone quality

Prime Movers and Their Accessories

ROCKER ARM FOR VALVE-IN-HEAD MOTORS.—W S Lee 211 Broadway, Paducah Ky An object of the invention is to provide a rocker arm which is comparatively noiseless due to the fact that it contains a spring which takes up the play A further object is to provide a two part rocker arm having a spring between the two parts, said spring being housed within the body portion of the rocker arm in such a manner as to be securely retained

CARBURETOR.—A A Hansen and E M Silkas Clinton Iowa The invention has for its general objects to provide in the mixing chamber of a carburetor mechanical means for causing the liquid fuel to be sprayed into the chamber and to be further acted upon centrifugally for producing an extremely fine mist so that a better fuel mixture can be obtained

FEEDER.—J J Stewart 2831 Peabody, Bellingham, Wash The object of this invention is to provide a feeder especially adapted for feeding boiler compounds wherein the rate of feed is controlled directly by the velocity of the feed water in the feed pipe With this device the feeder may be used to feed a compound of higher or lower specific gravity than water

Railways and Their Accessories

TROLLEY POLE ARRESTER.—R B Spikes, Fort Bragg Cal This invention has for its object to provide mechanism in connection with trolley poles for automatically pulling down the pole when the circuit is broken to prevent the breaking of the trolley wire and injuring the pole When the trolley jumps the wire *a spring rotates* and the rope is wound up to pull down the trolley pole

TAKE UP DEVICE.—R B Spikes, Fort Bragg, Cal This invention relates to mechanism for automatically taking up the slack in the rope and for permitting slack to run out, as the pole moves up or down with the varying height of the wire, and is especially designed for use with the trolley pole arrester, mentioned above

CAR DOOR FASTENER.—W Kane, 141 Margaret St, Sarnia, Ontario, Canada. The object of the invention is to provide a car door fastener which is easily operable to secure or release the door, *being adapted to secure the* door in either closed or partly open position, which is effective to maintain the door closed against the *action of the shifting load,* which is of simple and durable construction and reliable in operation.

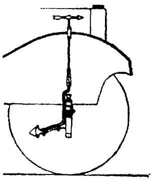
Pertaining to Recreation

COASTER.—O P Herwick, 1025 South *Jersey St, St John's,* Portland, Ore. The invention relates to coasters, or so-called skipmobiles, and has reference more particularly to propelling or traction means for this class of vehicle According to the present invention, it is proposed to equip a coaster such as a skipmobile with a mechanical means for propelling the device without requiring the manipulator to slide his foot over the surface of the ground

TOY GRASSHOPPER.—G. E. Ford, Olden, Texas. The purpose of the invention is to provide a toy of this character in which the mechanism *for effecting the hopping or jump*ing is adapted to be released automatically after the mechanism has been set so that the *toy can be placed upon a table or other* suitable support before it is actuated.

Pertaining to Vehicles

WHEEL ANGLE INDICATOR.—C. H. Luck, Box 15, Madera, Cal The invention relates to a device for enabling the chauffeur or other operator of an automobile to ascertain by means of an appropriate indicator carried by the machine the angular position of the front wheels and movable parts immediately associated therewith The indicator is of the type known as a plane which will indicate graphically the precise planes in which the wheels extend



A VERTICAL SECTION OF AUTOMOBILE EQUIPPED WITH INVENTION

AUTOMOBILE TOP.—E L Cronemeyer, 93 San Jacinto St., Redlands, Cal An object of the invention is to provide a collapsible top which is especially adapted for use on roadsters, touring cars or other vehicles, also motor boats and which can be easily and quickly operated by anyone, either to position the top in operation or telescope the same and house the top in a dust and waterproof compartment in the car body

ANTI SKID ATTACHMENT.—S. C Sherry, Park Ave, West Englewood, N. J An object of this invention is to provide an attachment which is particularly adapted for use on Ford cars and which when secured to the drive wheel will prevent slipping in snow or mud A further object is to provide an attachment which can be readily secured as *occasion may* require, and which can be manufactured and sold at a reasonably low price.

FLUID CLUTCH.—G Shirk, 154 E. Norwich Ave, Columbus, O. This invention aims to provide a clutch which is particularly adapted to be utilized in connection with vehicles such as *automobiles,* and when applied to a comparatively light automobile, to result in the dispensing of the various gears *used to vary the speed of the driven* shaft with respect to the driving shaft. When this clutch is applied to heavier cars, such as trucks, it will be necessary to provide only a single intermediate speed.

END GATE FOR DUMPING TRUCKS.—H Mecking, 223 W. 66th St, New York, N. Y The *invention relates more particularly* to power driven dumping trucks, its object is to provide a self opening gate or tail-board *normally* locked *in* closed position and adapted to automatically move into open position on swinging the body into dumping position, and to allow rocks to be passed out of the wagon body without interference by the gate or tail board

MUFFLER COVER.—G. H. Padgett, Pine Castle, Fla The *invention* relates to automobile exhaust mufflers, and particularly to the outer shell and means for permitting such shell to expand under certain conditions, the object is to provide an outer shell which may be removed or replaced without the removal or disturbance of the muffler ends, at the same time provide a shell which will be as strong as the ordinary outer shell, and equally effective.

Shall We Have a National Trade-mark?

(*Continued from page 175*)

might eventually destroy the good will which they have built up abroad by long effort and at great expense.

It is to be observed that the objections stated are usually made against a national trade-mark in the strict sense of the term and not against the use of a legend in the form of a plain statement of origin, like "Made in U. S. A." In fact many of the most active opponents of the national trade-mark project have advocated the adoption of such a legend to be placed upon all goods exported, subject, perhaps, to certain reasonable restrictions

A few months ago the British Merchandise Marks Committee, which had been appointed to consider various questions relating to trade-marks, reported that in its opinion no experience has yet been gained anywhere from which deductions as to the probable utility and effect of a national trade-mark for the United Kingdom or the British Empire could safely be drawn, and that in the absence of general agreement among the business men concerned there are grave objections to the adoption of such a mark. The majority of American business men would probably regard this as the sensible view to be taken in this country

Latin Foods in Old New York

(*Continued from page 170*)

niscent of the floating weed life of those tranquil village ponds of boyhood days The flavor is a quiet one—as of an Indian tea made with city-caught rain-water Everybody knows this peculiar taste

Among some of the Latin cafés in Gotham you can get the infusion thus, or served in a gourd, with bombilla—a tube to imbibe the essence through, for by this method the maté really is an essence, not sufficiently diluted to be termed a beverage. Maté is imported in rawhide bales, in barrels, and in cases filled with one-pound sheet-metal or cardboard containers, ready for the retail trade The writer has been familiar with maté for the past three decades, both in the land of its origin and here, and has found it best when used as a blend with Asiatic teas To Ceylon and Java teas, for instance, it imparts a suggestive suchong or kangu flavor—if your imagination is sufficiently active

The maté tree is at the same time one of the most beautiful shade trees of tropical America; and many a Paraguayan and Brazilian rancher has only to stroll into his well-shaded patio to cull a handful of leaves for his inevitable maté infusion It is used with a little raw sugar —never any such superfluities as milk or cream.

Tasajo is the sun-dried meat from the abattoirs of Uruguay, Argentina, et al. It is obtainable either salted or unsalted; the approved modern practice is to sun-dry it quickly, without a particle of salt—but this modern practice is nothing really new, being only a copy of the oriental saltless curing of meats. Salting is partly destructive of the nutritive properties of meats, to the extent that, in desalting (as by water-soaking), nutritive juices are washed out and wasted. Perfect preservation can be attained without the presence of salt.

There is a huge annual import into Manhattan of tasajo—some two thousand tons —far beyond any local consuming needs. Yet it is almost all snapped up as soon as it enters. This is because the dealers in shipping supplies requisition the greater part for the use of the crews—so South-American tasajo is carried over the seven seas, mostly for the crews of sailing ships.

It comes in many forms—strip, lariat, whole sides, paper-thin translucent sheets (one of its best varieties), as a coarse meal in sacks—the latter somewhat akin to a coarse Indian meat meal. The strip is made from the sides, cut in one continuous length and zig-zagged over long lines to dry in the sun, the desiccation is usually complete in half a day, the bright red flesh quickly turning black and hard Packed away in cases, it retains well its meaty odor, without even a suggestion of taint. Opening a case, a novice might think it was so much rope. The lariat form of tasajo resembles so much narrow pulley-belting—since for space economy it is tightly coiled like belting

The great advantage of tasajo is that it never has a trace of bone or other waste in any of its forms, even bits of fat only occurring by chance Eaten dry as it is—a common practice with the natives —tasajo is of good flavor, with appetizing meaty odor But it chiefly figures in soups Prior soaking in the same water in which it is later boiled will make it tender almost to the state of gelatine

Kasabi is a native Indian word applied to a root legume common throughout tropical America from which the breadstuff called cassava is made The tuber has some fifty different names and spellings in its various local habitats, but the Haytian patronymic given and the anglicized cassava are the best known This is the daily bread of millions all over Latin America It is regarded as the original bread of the western hemisphere—the next oldest being the maize tortillas Wheat bread is an introduction of modern times, as ages go, in the western hemisphere, while rye bread is unknown even yet south of the Rio Grande

Cassava is in fact a bread hardtack It has not a particle of sweetness, as the word cake sometimes used in designating it might suggest, but it has a slight potato flavor Many might pronounce it insipid, since salt or yeast or other leavening agents are never used in the baking The color is usually a beautiful cream-white, the disks are always thin, and are baked in sizes ranging from six to twenty inches in diameter The bread is at once nutritive and feebly aperitive, like whole wheat bread, hence its use in preference to any other bread by the aged among the natives Cassava has been imported and sold in Manhattan—principally among the Spanish-speaking—for the past half century or more

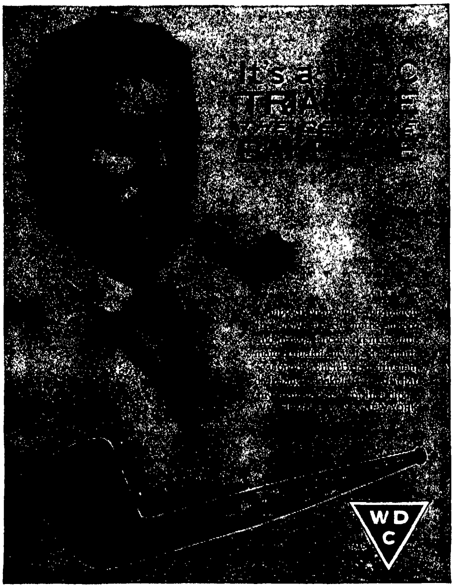
Little known nut wares from Spanish-America are the sapucaia nuts from the Amazon and Orinoco These are about the size of Brazil nuts, but with wrinkled shells The nut meat has a flavor that combines those of sweet almonds and filberts It is one of the most economically worth-while nuts of the globe It is sometimes called the nut of paradise, in reference to the primeval character of the upper Amazon forests where it originates

The jumbo walnuts of the west coast are sometimes so big that the measuring tape reveals a girth of six inches, more or less. These huge nuts are always choice and meaty The empty shells are sometimes hinged with a small fragment of thin leather glued on, and thus used for tobacco pouches, coin purses, etc.

The singu, or little baby cocoanuts from Chile, no bigger than nutmegs, yet with the characteristic three eyes and half a thimble full of milk, are worthy of passing mention.

There is too a big import of luscious tropical fresh fruits in season—as the custard apple, eaten with a spoon; the mango; the sapodilla; the guava, for preserving, green cocoanuts with a beautiful glossy flush, imported for their distilled water-like content, a most refreshing drink; and some two-score other fruity delectables.

In fact, no visitor to Manhattan from any corner of South or Central America or the West Indies need feel that he is a stranger in a strange land so far as his food is concerned; for whatever his country, he can find in New York most of its good things to eat.



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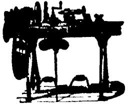

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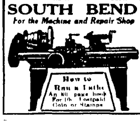

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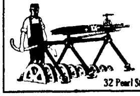

NEW BOOKS, ETC.

An Epitome of Hydrotherapy By Simon Baruch, M D, LL D Philadelphia and London W B. Saunders Company, 1920 8vo, 205 pp, illustrated.

As the author of the first original work on this subject in the English language, Dr Baruch commands attention in his latest contribution to this important branch of remedial treatment Charging that costly hydrotherapeutic instalment often fails to achieve its full possibilities, he sets forth the laws of shock and reaction, stresses the necessity for precision, and details the procedures directed toward general effects as well as those adapted to various diseases The architect, as well as the physician and nurse, may profit by the instruction

The Primer of Shorthand By Jerome B Howard Cincinnati The Phonographic Institute Company, 1920 16-mo, 99 pp, illustrated

The author, known to Pitmanic writers through his widely used, 'The Phonographic Amanuensis,' has produced in this little book a distinct aid to the beginner It deals only with monosyllables, that portion of the system employed in writing words of one syllable is thoroughly expounded, with numerous exercises in their use

Mathematics for Engineers Part II. By W N Rose, B Sc New York E P Dutton and Company, 1920 8vo, 419 pp, illustrated

This volume completes a work directed toward strictly practical ends It is mainly devoted to the differential and integral calculus, with chapters on spherical trigonometry and mathematical probability The treatment is based on algebraic principles, amplified and explained by graphic proofs and constructions The various branches of mechanical and electrical engineering call for applications of the calculus that are here exampled with commendable clarity The two voumes furnish all mathematical work needed in all branches of engineering science

The Need of Automatic Train Control. By W M Camp Chicago The Railway Review Company, 1920 8vo, 64 pp

The editor of the *Railway Review* in this pamphlet discusses accidents, signaling and block systems, and summarizes the development and present status of automatic train control The various systems of, and experiments in, automatic control are described and some consideration is given to costs The digest is worthy of wide circulation.

Gas Warfare By Edward S Farrow New York E P Dutton and Company, 1920 8vo, 258 pp

Gas, which turned the war into a battle of *chemists is likely to be utilized to even more* terrific effect in any future conflict As instructor at the United States Military Academy, the author had access to official records, and his book covers the various toxic gases, defense equipment, tactical employment of gas and chemical shells, hand grenades and the manufacture, storage and transport of chemical weapons and equipment with the duties and organization entailed by their use It is a text for the soldier-student

The Field Manual By Arthur Lovat Higgins, B Sc New York, Isaac Pitman and Sons, 1920 12mo., 938 pp, illustrated

In the training of engineers, surveying must be so presented as to meet the practical demands of varying circumstances This is the aim of the present noteworthy text, which embraces the gist of British and American practice and forms a systematic digest of methods and operations, with field problems for use in surveying courses The use of chain, level theodolite, sextant and compass is developed in detail, the section on "The Office has much sound instruction on scales, maps and calculations and an appendix carries the necessary formulæ and tables

Motion Study for the Handicapped. By Frank B Gilbreth and Lillian Moller Gilbreth, Ph D New York: E P. Dutton and Company, 1920 8vo; 165 pp, illustrated

It has been proved that those crippled by war or industry may by proper training, again take a useful place in the world's work. Two leading experts in the field of motion study here lay a complete system before us By subdividing the field of the motion picture into squares, and introducing a continuous torque clock, time and distance are made to exhibit mutual relations, and we are enabled to produce a simultaneous motion chart The animated diagram is another means of efficient study and teaching The book tells precisely

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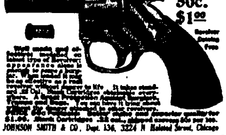

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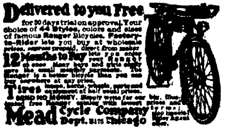

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COMMON SCIENCE. By Carleton W. Washburne. Yonkers-on-Hudson, N. Y.: World Book Company. 8vo.; 390 pp; illustrated

To tell children what they want to know is to lead them to want to know what they should know, this is a new kind of high school text based on that belief. It answers 2,000 questions asked by real children, these are classified by the author according to the scientific principles involved, so that the resulting text has unity and sequence. A "Manual of Information" for teachers, in pamphlet form, has laboratory lay outs and a list of the needed supplies

VOCATIONAL ARITHMETIC. By Clarence E Paddock and Edward E. Holton. New York and London: D. Appleton and Company, 1920. 12mo.; 232 pp, illustrated.

The requirements of the vocational school and the shop call for an arithmetic especially adapted to practical purposes. Two experienced men, skilled in engineering practice and the teaching of that practice, here present the various branches of arithmetic in the simplest possible way, and set numerous every day problems representative of those encountered in shop work, carpentry, foundry work, masonry, and excavation

THE AUTOMOBILE OWNER'S GUIDE. By Frank B Scholl. New York and London: D Appleton and Company, 1920. 12mo, 338 pp., 154 illustrations

The selection of and care for the car that best suits the purpose for which it is destined is a matter that might well be given more consideration than it generally receives. This Guide will help the buyer to pick the right car to drive it properly, and to keep it in good repair. The instruction is conversational, expressed in the simplest form, yet thoroughgoing. The author's wide teaching experience in peace and war has enabled him to turn out a very practical manual

AMERICAN GUNS IN THE WAR WITH GERMANY. By Edward S. Farrow. New York: E P Dutton and Company, 1920. 8vo; 223 pp

The combination of science, engineering and industry that, during the war, enabled us to supply a catalog of 100,000 separate ordnance items, establishes a "new American record" of which we may well be proud. Major Farrow outlines the staggering problem as it was handed to us, deals in separate chapters with rifles, machine guns, trench weapons, heavy guns, and railway and motorized artillery, and shows how new and complex devices were designed and produced in the face of almost insuperable obstacles.

THE DAWN OF MODERN MEDICINE. By Albert H. Buck, B.A., M.D. New Haven: Yale University Press, 1920. 8vo., 288 pp; 37 illustrations.

In the latter half of the eighteenth century the science of medicine witnessed a remarkable revival. With the aid of old French, English and Latin treatises, Dr Buck reconstructs conditions in western Europe, and describes the personalities and activities of those to whom the surge forward was due. The work is illustrated from old prints and paintings, and holds as much interest for the intelligent layman as for the physician and student

AMERICA AND THE NEW ERA. Edited by Elisha M. Friedman. New York: E. P Dutton and Company, 1920. 8vo.; 500 pp.; illustrated

In the revaluation of standards following the shock of war, questions of social and political adjustment are no less insistent than those of industry. This symposium lays before the thoughtful man the conclusions of some of the foremost students as to the real effects of the war, the illumination of prewar conditions, and the development of new ones. The work is a worthy sequel to "American Problems and Reconstruction," which dealt with economic and financial problems.

STARTING AND LIGHTING TROUBLES, REMEDIES AND REPAIRS. By Harold P. Manly. Chicago. Frederick J. Drake and Company, 1920. 16mo.; 459 pp.; illustrated.

Any repairman with some slight knowledge of electric lighting and starting principles will be aided by this manual to a complete mastery of diagnosis and adjustment. Trouble location charts are followed by approved tests for determining the kind of fault existing; this section includes electrical testing equipment and its use. The final section consists of diagrams of both internal and external wiring, with the characteristics of and specifications

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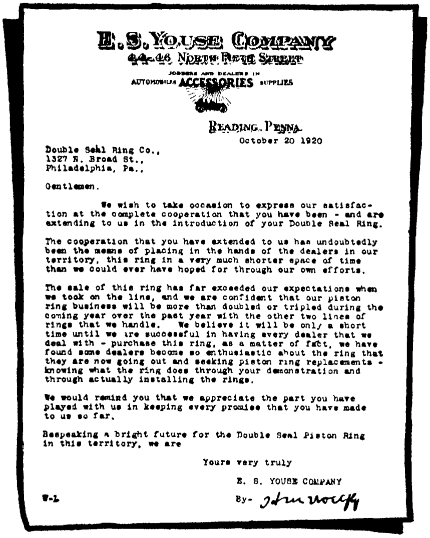
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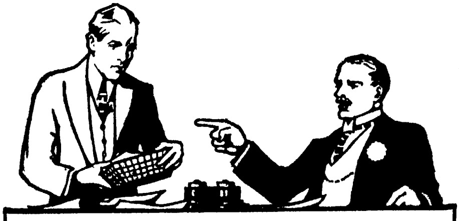

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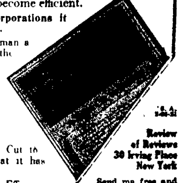

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AMIENS BEFORE AND DURING THE WAR. Milltown, N. J.: Michelin Tire Co., 1920. 8vo., 56 pp., illustrated; maps and plans

The traveler is told just what he should look for in Amiens, from its perfect Gothic cathedral to its macaroons and potted duck. Nine shells hit the cathedral, but with little damage Its wonders are pictorially unfolded, as are those of the Picardy Museum, and in Rheims is the oldest playhouse in France. There is much information for the motorist.

THE MERCHANT MARINE MANUAL. By Capt Eugene E O’Donnell. Boston: The Yachtsman’s Guide, 1918. 16mo.; 293 pp., illustrated.

This collection of nautical information was primarily intended for apprentices on our training ships, but all engaged in seafaring occupations will find its hints on seamanship, safety, sailing rigs, design marine engines and nautical instruments productive of a better knowledge and mastery of their duties and an aid in passing examinations for higher grades.

THE MICROBIOLOGY AND MICROANALYSIS OF FOODS. By Albert Schneider, M.D., Ph D Philadelphia P. Blakiston’s Son and Company, 1920. 8vo; 262 pp.; 131 illustrations

While this text bears chiefly upon military requirements, all food analysists may profit by its crisp yet comprehensive instruction. It includes the microanalytic examination of water and other beverages and gives a working basis for finding the decomposition limits of food by the same direct method. As combined text and laboratory guide, it is adapted to college needs; and it proposes food ratings founded upon years of solid experience, with an endeavor to be fair both to manufacturer and consumer The close relation of suitable food to race welfare makes this a subject of great importance.

INVENTIONS Their Development, Purchase and Sale By William E Baff. New York. D Van Nostrand Company, 1920. 8vo; 230 pp.

Profitable marketing of his invention is the goal of the inventor—a goal seldom obtained, for invention and salesmanship are qualities rarely found in one individual This book sets forth broad business principles and contains many suggestions for interesting capital, choosing a partner, and engaging in business for oneself Other vital questions are handled What is my patent worth? Just what privileges does it confer? What are its best talking points? These are answered in a manner that should set the feet of the average inventor in the right path, and enable him to avoid many mistakes

DYNAMIC SYMMETRY. The Greek Vase. By Jay Hambidge New York and New Haven, Conn· Yale University Press, 1920 4to, 161 pp; illustrated; 16 plates

The later, and better, Greek design abandoned the linear unit of measurement, which produces “static symmetry,” for a method based upon area, which produced the exquisite vase we now know as a striking example of “dynamic symmetry” To such conclusions the author’s deep study has led him This beautiful book recovers the technical methods of classic Greece and shows the correspondence of their results with form arrangements in plants, tracing both types of form to a natural law that affects design as perspective affects realistic representation.

CERAMIC CHEMISTRY By H. H. Stephenson London Davis Brothers, 285 Strand, W. C. 8vo; 91 pp.

The questioning of the conclusions of Seger and Berlin by the newer school of ceramists is reflected in this work. The author regards ceramics as highly suitable for college study, in that it provides a natural means of transition from geology to chemistry, and unites these branches with mathematics, physics, and engineering. The text discusses geological origins, and carries the student through all processes from clay analysis to firing the ware and testing the finished product.

MOTOR CAR UPHOLSTERING Philadelphia: The Hirst-Roger Company, 1920. 8vo.; 180 pp., illustrated.

The upholstery of a car ministers to two needs, appearance and comfort. The aim here is to familiarise the student with the technical and artistic requirements of all-round trimming, a trade that offers a remunerative occupation to the ambitious man with some creative imagination. The book makes him acquainted with the shop, materials, tools and methods, plain and tufted work, and fitting and finishing. It is a distinct aid toward the neatness, comfort and durability that mark the work of the successful designer and trimmer.

THE SUPER-ICARUS. By Leslie [illegible], Boston: The Roxburgh Publishing Company, Inc., 1920. 8vo.; 141 pp.

A superman and a transcendentalist clash in this dialogue. Shrewd hits are delivered by both combatants, and the newer concepts of matter, energy, time and space, of the ether, the fourth dimension and relativity, are ingeniously woven into the argument in terms that the thoughtful reader can follow and understand.

COMPRESSED AIR POWER. By Albert W. Daw and Zacharias W. Daw. New York: Isaac Pitman and Sons. 8vo.; 375 pp.; 75 illustrations, 40 tables.

The use of compressed air is continually being extended. This comprehensive study deals with its compression; expansion, exhaust and flow, giving worked-out examples. It investigates the air lift pump and mathematically analyzes its action; types of compressor valves, controls, and receivers are illustrated and described; and the return air system with its great potentialities is explained at length. All concerned in the design and use of compressed air plant and machinery may find here forceful instruction, exact information, and practical suggestions.

THE LEADING FACTS OF AMERICAN HISTORY. By D. H. Montgomery. New York and Boston: Ginn and Company, 1920. 8vo., 500 pp.; maps and illustrations.

This school text is so well known that it is only necessary to say that the new edition incorporates more recent events in the same spirit of simplicity, accuracy and impartiality. The significant facts of history are marshalled, with unerring judgment, and are made to march before the reader’s eye in a colorful procession. Thorough revision is discernible, and our part in the great war is briefly indicated. The illustrations and maps have been carefully selected.

GAGE DESIGN AND GAGE-MAKING. By Erik Oberg and Franklin D. Jones. New York: The Industrial Press, 1920 8vo.; 310 pp.; illustrated.

There is a distinct relationship between the gages used and manufacturing costs. This work insists that tolerances be carefully based upon working requirements, since there is such a thing as unnecessary and costly accuracy. The treatise presents the development of gaging systems for interchangeable production, the design of numerous types, precision machining operations, and the modern devices for gage measurement It emphasizes the importance of the relation between the gaging system and the design of jigs and fixtures, establishes basic principles, and skilfully sets forth methods of measuring and testing with generous illustrations.

DURUY’S HISTORY OF FRANCE. Translated by M Cary Edited by James F. Jameson. Continued to the year 1920 by Mabell S. C. Smith New York: Thomas Y. Crowell Company, 1920. 8vo.; 792 pp.; colored maps

First published here in 1889, this standard work appears in a new dress, with an appendix that should make it doubly attractive to the school, the library and the home.

SYMBIOSIS. A Socio-Physiological Study of Evolution. By H. Reinheimer. London. Headley Brothers, 1920. 8vo.; 295 pp.

Evolution, like the god Siva, has two faces: Darwin painted the sterner one. Our present author limns the fairer countenance, calling it Symbiosis, but he rejects that definition of symbiosis which includes parasitism, its very antithesis Some remarkable but strongly supported conclusions emerge; the vital rôle of cross-feeding in evolution, the dependency of food’s effectiveness upon the measure of biological coöperation that went to its elaboration; the tendency of predaceous feeding toward monstrosity and the extinction of species; the conveyance by food of direct psychic influences We may say of this author’s work what he himself says of symbiosis—it has stimulative, integrative and directive force.

THE GREAT STEEL STRIKE. By William Z. Foster. New York: B. W. Huebsch, Inc., 1920. 12mo.; 265 pp.; illustrated.

The conscientious observer demands both sides of the question, and will welcome this inner history of a great strike from the viewpoint of a chief organiser. In conclusion, Mr. Foster frankly tells what is, in his opinion, the ultimate aim of trade unionism. In admitting that higher wages [illegible] but a temporary amelioration, he [illegible] the chief weakness of the strike as the [illegible] of labor.

IN THIS ISSUE:

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MAKING WEATHER TO ORDER

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15 APR

BUILDING A SKELETON PATTERN FOR A WATER-TURBINE SPIRAL CASING.—[See page 189]

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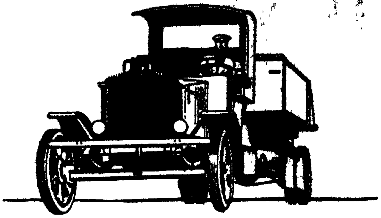

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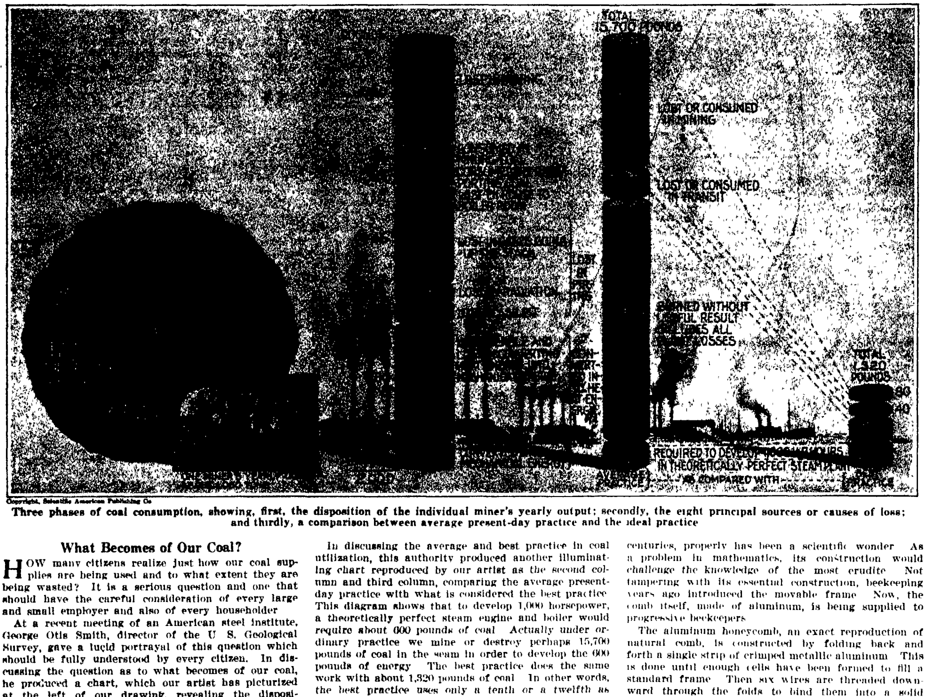

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Three phases of coal consumption, showing, first, the disposition of the individual miner's yearly output; secondly, the eight principal sources or causes of loss; and thirdly, a comparison between average present-day practice and the ideal practice

What Becomes of Our Coal?

HOW many citizens realize just how our coal supplies are being used and to what extent they are being wasted? It is a serious question and one that should have the careful consideration of every large and small employer and also of every householder

At a recent meeting of an American steel institute, George Otis Smith, director of the U S. Geological Survey, gave a lucid portrayal of this question which should be fully understood by every citizen. In discussing the question as to what becomes of our coal, he produced a chart, which our artist has picturized at the left of our drawing, revealing the disposition of the individual miner's yearly output of about 1,000 tons. The ball of coal shows the uses to which this 1,000 tons are put, including both anthracite and bituminous coal.

In the matter of losses in using coal there are some surprising features In all there are eight principal sources or causes of loss. The first column of our chart represents these graphically. Under ordinary conditions of mining and firing, out of every 2,000 pounds of steam coal in place in the mine, only about 76 pounds are converted into mechanical energy—a most surprising fact. The other 1,924 pounds are either unavailable or are absorbed by the eight losses shown in the sections of the columns. This means a recovery, as proven, of only 4 per cent of the resource, assuming steady operation. Allowing for further losses due to bad load factor, as is shown in the second column, the recovery, as proven, becomes perhaps 1 to 2 per cent.

In discussing the average and best practice in coal utilization, this authority produced another illuminating chart reproduced by our artist as the second column and third column, comparing the average present-day practice with what is considered the best practice This diagram shows that to develop 1,000 horsepower, a theoretically perfect steam engine and boiler would require about 600 pounds of coal Actually under ordinary practice we mine or destroy perhaps 15,700 pounds of coal in the seam in order to develop the 600 pounds of energy The best practice does the same work with about 1,320 pounds of coal In other words, the best practice uses only a tenth or a twelfth as much as the average The losses in average practice here shown are calculated as in the first column, except that in this case allowance is made for the additional loss due to bad load factor

Honeycombs of Aluminum

THE uncanny instincts of the honey bee, marvelous as they are, can be matched by man with human ingenuity which insures much more efficient honey production The instincts of the bee which convert a tree hollow into a hive are as wonderful, if not more so, than the human intelligence which conceived and perfected the modern hive, but the modern hive facilitates the vastly better storing of honey So is it also with many other details of modern apiary management. The honey bee attains maximum efficiency only under human assistance and control.

A new demonstration of this is a recent invention, the aluminum honeycomb. The honeycomb, for centuries, properly has been a scientific wonder As a problem in mathematics, its construction would challenge the knowledge of the most erudite Not tampering with its essential construction, beekeeping years ago introduced the movable frame Now, the comb itself, made of aluminum, is being supplied to progressive beekeepers

The aluminum honeycomb, an exact reproduction of natural comb, is constructed by folding back and forth a single strip of crimped metallic aluminum This is done until enough cells have been formed to fill a standard frame Then six wires are threaded downward through the folds to bind them into a solid whole To facilitate disinfecting, small holes connect the cells of the two faces, so that boiling water or live steam can freely pass through

The aluminum honeycomb has several outstanding advantages Melting down cannot occur Immediate storage or egg space is always available Disease is controlled without loss of fixtures Danger from moths is minimized Drones are most effectively controlled

The natural question arises, how do the bees take to the metal? Some special pains are involved at first When manufactured, the aluminum combs are given a thin coating of beeswax Beekeepers use them first as extracting combs, preferably When introduced for brood rearing purposes, the beekeeper employs combs which have already been used by the bees, and an aluminum comb is alternated with a natural comb The best time to start bees on the combs is during a good honey flow

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A Call for Cooperation

THERE is no other great center of population, industry and trade activity which calls so loudly for complete cooperation in handling its collective interests as the Island of Manhattan and its surrounding and densely peopled residential and industrial district. Here the watchword of success in solving the problem, is cooperation—cooperation of the most earnest and all-embracing type. A long step toward this goal was taken when the two states of New York and New Jersey appointed, some two years ago, the New York and New Jersey Port and Harbor Development Commission. After exhaustive and highly expert study of the question, a joint report has been issued which ought to be read by every citizen living in the district covered by the report, and this means by about eight million people.

If this great problem is to be solved in a workable fashion, so that passengers and freight may be transferred in the least time and for the least cost, we must realize that the physical obstacle to transportation presented by the Hudson River is not necessarily a political obstacle. Hitherto it has prevented municipal and state coöperation; so, also, in less degree have the waters of the Harlem, the East River, and New York Bay.

Hitherto, concerted action in matters of transportation has been somewhat handicapped by sectional prejudices and differences within the city of New York itself; while on the New Jersey side of the river, the political subdivision is represented by more than forty separate municipalities, ranging from Newark, a city of nearly half a million inhabitants, down to small boroughs and townships. Hitherto these multiplied interests have pulled in as many different directions. If we are to solve the problem of this port they must pull together. *E pluribus unum* as a motto is as fundamental a necessity here as it is in its broader national significance.

Never, as the report states, has there been any general comprehensive plan for the terminal development of the port considered as a whole, to which all parties interested have subscribed or toward the realization of which all interests, municipal and private, have coöperated. The urgency of the matter is realized when we remember that some eight million persons live within 25 miles of the Statue of Liberty, and that about fifty per cent of the foreign trade of the United States passes through this port. All of these people, the report reminds us, must have food and all help to pay the millions of dollars wasted annually through inadequate market facilities, lack of economical means of local transportation of foodstuffs, and the resultant excessive handling, excessive trucking, and excessive exposure to the elements. All wear clothing, and all share in the high expense of delivering either finished products received from elsewhere or raw materials used here in manufacture. Housing, we do not have to be reminded, is an acute problem, and the inadequacy of terminal facilities for handling building materials discourages new construction. Occasionally, marine and other strikes cut off the flow of food stuffs. The weather, too, plays its part. Coal is frozen in cars in the Jersey yards, ice jams prevent free movement of coal barges, so that although there may be much coal within the district, transit and lighting companies have been threatened with shutting down for lack of fuel.

But in addition to the eight millions within the metropolitan district, there are about six millions in New York and New Jersey beyond the limits of the district. They, too, pay part of the burden of inadequate terminals at New York. For this port is a primary distributing center for places as remote as Buffalo and Atlantic City. The problem has also a national aspect. The trade of the whole world has settled upon New York as the natural gateway between the interior of the United States and itself. Nearly all the most important transatlantic lines have their terminals here. Proper facilities for shipping grain through this port, which we have not at present, would help the farmers of the country.

In a recent article we referred to the building of the North River Bridge as a solution of this problem. The bridge would cover the whole phase of railroad and rapid transit service and automobile and general vehicular traffic. The scheme of the Port and Harbor Commission deals only with one element of this great question, namely, that of the distribution of freight, the food stuffs and miscellaneous lighter merchant freight being brought from a distributing yard in Jersey City by means of tunnels to certain distributing warehouses scattered throughout the city. This report will be taken up in fuller detail in an early issue, when we shall illustrate the very novel and extremely interesting method proposed by the Commission as a solution.

Decline of American Aviation

IT is best to look facts squarely in the face and realize that there has been a deplorable decline in American aviation since 1918. Equally true is it that although the future lies in the hands of Congress, that body has done very little to stop the debacle. If Congress shows a helpful attitude, passes the necessary legislation and provides a reasonable appropriation, this country, which saw the birth of aviation, will take its rightful place as its leading modern exponent.

Immediately after the Armistice, American aeronautics consisted in the United States Air Service of 21,000 officers and 175,000 men, and in Naval aviation there were over 3,000 officers and 47,000 men. We possessed 15,000 American-built planes and 20,000 engines. Invested in the airplane industry was about 100 million dollars of capital, and the force of employees, including the spruce force, included 250,000 men and women. Today, the United States Air Service consists of 1,090 officers and 8,343 men, and in Naval Aviation there are 624 officers and 4,627 men with aviation rating. Our equipment consists of obsolete war material and a few hundred experimental aircraft and engines. As to the industry, plants allied with the aircraft industry during the war have reverted to their original lines of business, and the capital remaining in this industry has shrunk to 10 million dollars or less. It is doubtful if the employees all told number 2,000.

Immediately after the Armistice, our allies undertook the encouragement of civil aeronautics as the surest and most economical means of providing national security in the air. They did this by the passage of sympathetic laws regulating aerial traffic, by provision against dumping of obsolete foreign aircraft, by the establishment of air routes and terminals, by the development of the air mail, and lastly by recognition of the fact that the aircraft industry cannot survive if the Government compete with it in the production of planes and engines. Hence, our allies limit work in Government shops to experiment and research, and depend upon private industry for the development of design and all manufacture and procurement.

Except for the establishment of the Air Mail Service, Congress has done but little for the industry in this country, and it has rewarded the fine results achieved in our Air Mail Service by cutting down the modest sum asked for its continuance and improvement. Every citizen is, or should be, interested in this question, and he should make it his duty to impress upon the minds of the Senators and Representatives from his district that he is concerned in seeing the airplane industry stimulated by liberal Federal support.

Jane's Fighting Ships

THERE is probably no book devoted to naval affairs that is more widely known than the naval annual entitled "Jane's Fighting Ships," which was founded in 1896 by Fred T. Jane and is now edited by Oscar Parkes, who is well known as a contributor to SCIENTIFIC AMERICAN readers by his illustrative and descriptive work, and by Maurice Prendergast. The 1920 volume is a comprehensive work of 577 pages, and like its predecessors is distinguished by the great extent and detail of its naval information. It contains a photograph or a diagram of practically every warship of importance in the various navies of the world, and with each illustration there is a mass of data affecting the armament, motive power and date and place of construction, together with a series of notes which will be welcomed by every student of naval affairs.

The editors state that the recent issues have been hampered by the disabilities arising from the late war, such as the partition of ex-enemy warships among the Allied and United States navies, the nomination of warships chosen for the German post-war fleet; and the disposal of unfinished German naval vessels.

In the British, French and Italian naval sections full-page tables have been added giving details of ex-enemy warships received by each country for "propaganda and experimental purposes." Similar paragraphs have been added to the United States and Japanese naval sections. These vessels are to be broken up, or destroyed under experimental tests, and they do not constitute an addition to the strength of the navies of the powers to which they have been allotted. Hence, in this annual there will be found no illustrations and descriptions of these ex-enemy vessels. The same considerations account for the total abolition of the former Austrian Navy section.

An important improvement relates to the dates attached to photographic illustrations. These dates give approximately the year of the first commission of the vessels, or they give the edition of the annual in which the views first appeared. Also, the matter of torpedo craft plans has been thoroughly investigated and diagrams have been added of all modern types of destroyers and torpedo boats, wherever they could be secured.

Under the head of Great Britain will be found, for the first time in this annual, photographs that cover the entire page. This has been rendered necessary by the rapid growth in size of the modern battle cruiser, for the ordinary photograph, five inches in width, is found to be inadequate to depict clearly the details of these great ships. Consequently, we find that the photographs of such ships as the "Renown" and the "Hood" cover the full 10-inch width of the page, as do also the outboard profiles and deck views of these ships.

The silhouettes of United States warship types include this year a considerable number of new official drawings, while the ship pages comprise plans of all the most modern types now under construction. These United States photographs were placed at the disposal of the editors by the United States Naval Recruiting Bureau. Due attention has also been given to the important subject of the establishment of naval bases required by the new United States Pacific Fleet.

Japan also receives special attention this year, including new and exclusive information as to the past and projected expansion of the "Imperial Navy." A unique feature is the collection of photographs of the Japanese submarines, the first of its kind ever published. Novelty is given to the sections of France and Italy by the addition in this issue of various ex-German and ex-Austrian warships which are given under their new French or Italian names. Under the Italian section will be found photographs of those most interesting vessels, the "Italian Mobile" Batteries which were called into existence during the war and played such an important part therein.

Electricity

Electric Traction on Canals is being discussed extensively in France, at present, in view of the large volume of traffic which these waterways are to handle in the no distant future. The suggestion has been put forward that the St Quentin Canal be supplied with electric current by an overhead trolley wire, and that special electric tractors be employed to haul the barges through the locks. One of the several electric tractors being experimented with will soon be illustrated and described in our columns.

Venezuela's Radio Plans.—A definite program has been established by the Venezuelan Government for the installation of twenty-two secondary wireless stations. Contracts have already been awarded to an American citizen for installing wireless towers at the following points: Maracay, San Cristobal, Maracaibo, Puerto Cabello, Coro, La Guaira, and Ciudad Bolivar. The station at Maracay has been equipped with a five-kilowatt set purchased from an American concern, and orders have been placed with American concerns for three other 5- and one 3½-kilowatt set

Errors in Radio Direction Finding are believed to be due to two causes: First, deviation of the waves in their passage through space; secondly, local interference at the receiving end. The first cause is probably incurable, according to a recent issue of *Radio Review*, but the second is now being investigated It is pointed out that in practical work attention is concentrated on eliminating errors rather than on investigating them, and observers are asked systematically to collect data of such phenomena for investigation Local errors are roughly grouped under four headings 1 Masses of metal, especially iron 2 Large conducting or partially conducting surfaces 3 Tuned circuits, and 4 Long-distance telegraph and telephone lines

A Mercury Contactor that fits into fuse clips has been placed on the market by an American manufacturer This forms a hermetically sealed circuit-breaking device which can be used as a switch or to make and break an electric circuit rapidly The contactor consists of a glass tube containing a quantity of mercury, an inert gas and two central electrodes with a gap between. The electrodes are connected to outside brass caps at each end of the tube The simplest type of these contactors is operated by being tilted so that the mercury makes and breaks the circuit between the electrodes In the relay form of construction the necessity of tilting is eliminated by the use of a hollow iron cylinder which is lined with an inner sleeve of porcelain The gap between the electrodes is inside of the iron cylinder.

Gases for Electric Lighting.—In a recent paper read before the American Institute of Electrical Engineers, D. M. Moore traces the early development in the use of luminiscent gases as sources of light leading to the Moore tube systems containing nitrogen and carbon dioxide Such systems operate at a pressure of several thousand volts The introduction of neon on a commercial scale enabled much smaller tubes to be used Lamps with a 3-m gas column will operate on 220 volts at about 0.5 watt per candle-power without any transformer, but some starting device is necessary However, a type of neon lamp has now been developed experimentally which will fit into an ordinary glow-lamp holder on a 220-volt circuit, and requires no starting device. Such lamps depend on the utilization of the negative glow, and yield a yellow light of about 1 candle-power at present consuming about 15 watts per candle.

Increased Use of Electric Service.—Some very pertinent remarks were recently made by Donald McDonald, vice-president and general manager of a gas and electric company of Louisville, Ky, in the course of an interview He says in part "There is a bright side to the public utility situation created by the war Users of power have had their attention called to the certainty and reliability of central-station service. With coal at famine prices and difficult to get even at these prices, power users have turned more and more to electric service; the result has been an enormous increase in the output of electricity for power Even in the field of domestic lighting people have found that plenty of light in their homes means a great deal in the way of comfort and comparatively little in the way of cost. These conditions will remain after the causes which brought them about have passed away. Cost of operation is slowly, but surely, coming down, while people who have become acquainted with the luxury and convenience of electricity will continue to use it much more generously than they did in past years."

Science

Caterpillars As Food.—At a recent meeting of the Entomological Society of America, Mr J. M. Aldrich of the National Museum stated he found a small tribe of Mono Lake Indians which caught and dried a ton and a half of caterpillars in a season for food

Death of Prince Kropotkin.—It is not often that a man of science occupies the rôle of revolutionary leader. This is the case with Prince Peter Alexeivitch Kropotkin who has just died He was a great Russian geographer and writer on natural history subjects, but twas a proscribed Nihilist as well He had a most picturesque existence and was identified with all kinds of plots and revolutions. He wrote many scientific articles for English reviews

Approaching Visit of Madame Curie.—The foremost woman scientist, Mme Curie, who with her husband discovered radium, will visit this country in May, to receive in person the Willard Gibbs gold medal, which no woman has ever before received Incidentally, she will be presented with the desire of her heart for "a gramme of radium all my own" The women of America will make the present unassisted by donations from men The market price is now about $130,000.00 a gramme.

The First Whale with Hind Legs has been caught in British Columbia This was described at a recent lecture held at the American Museum of Natural History. The legs project some four feet from the body near the tail, and are about six inches broad, the bones being covered with a thick layer of blubber which may or may not have contained muscle The whale, a female fifty feet in length, was unfortunately not preserved at the Victoria whaling station, where it was brought in, and one of the legs was broken off by those making the capture

Carbon Black under a Cloud.—It is strange that one of the lightest and blackest substances known should be under a cloud, even if a legal one This valuable substance which makes printing possible, which makes rubber tires comparatively cheap and which makes our fountain pens black, is seriously menaced by laws and legislators in a number of States in the natural gas belt These astute gentlemen have suddenly discovered that the country is going to ruin, owing to the wasteful use of natural gas in producing carbon black, and in Wyoming the penalty is $1,000 a day for attempting to make the fluffy pigment which was described a few weeks ago in our columns

Telephone Pole Specifications.—At the request of the Overhead Systems Committee of the National Electric Light Association the Forest Products Laboratory is collecting data on the taper and strength of various pole species including Southern Yellow Pine Chestnut, Western Red Cedar and Northern White Cedar, in order to check up, or, if need be, revise their standard specifications for poles Data are also being collected on the efficiency of various treatment commonly used for poles These data are based on the results of service tests by the Forest Products Laboratory that have extended over a period of approximately 14 years

Prevention of Wood Borers.—A special survey is being made of conditions in San Francisco Bay where marine borer depredations are very serious just now and causing excessive damage A representative of the U S. Forest Products Laboratory is carrying on the investigation in coöperation with a local committee It is expected that the San Francisco study will require about three months, and that the data obtained will be of considerable value to engineers who are concerned with the construction or maintenance of marine structures An investigation on the prevention of marine wood borers has been very much needed for years but due to lack of funds it has been impossible to make satisfactory progress

Currents in the Maine Gulf.—Some interesting explorations have recently been made in the so-called Gulf of Maine 330 drift bottles were set out in the bay and 16 of these bottles were picked up off the shores of the Gulf of Maine Each bottle contained a Canadian post card to be sent to the Biological station with the offer of a reward to the finder who wrote the time and place of finding and posted the card The larger bottles had a galvanized iron drag which was attached so that the bottle was hung at a depth of 3 fathoms. This was done to minimize the effect of the wind. Seven out of the 11 bottles which went to Cape Cod were found between seventy and eighty days after being sent out The distance from the Bay of Fundy is about 300 nautical miles; therefore, the rate of drift was 4 nautical miles per day There was a map of the course of the drift bottles published in a recent issue of *Science*

Aeronautics

Utilizing the Marshes as Landing Fields.—A recent suggestion to utilize the marshes as landing fields comes from Joseph A Steinmetz of Philadelphia His suggestion calls for the stretching of a strong net over the ground upon which the airplane is to move

Whale-Spotting from the Air.—A group of adventurous British airmen is about to demonstrate how airplanes may be used to advantage by whaling companies for whale-spotting It is believed that the advantages of aerial spotting would greatly augment the efficiency of whaling fleets and in this manner more than compensate for the expense of the air service

Mathematically Correct?—From a report received in Paris from Berlin, it appears that up to November 3rd the Inter Allied Aeronautic Commission had taken possession of 28,000 aero-motors—that is, 12,000 more than the Germans said they possessed The Commission is also said to have confiscated 18,000 machines, these being, it is understood delivered in accordance with the terms of the armistice

Rain by Airplane.—Following the report of experiments in the Transvaal to produce rain by an airplane dropping dust on the clouds comes word from Winnipeg of another scheme with the same end in view The Canadian scheme calls for the spraying of liquid air in the clouds in order to cause the condensation of the moisture in the atmosphere Truly, these schemes are very much like our old friend, the rain producing and anti hail cannon in somewhat new dress

The Danger of High Speeds.—De Romanet had a very narrow escape recently when trying to beat his speed record of 292.68 km per hour made previously on the same day His engine was just "revving" when the 'fairing pot' in the airscrew broke, bursting his airscrew, the debris damaging his bottom plane, undercarriage and radiator Any pilot without his ability would certainly have been killed, as he was doing well over 180 miles per hour at the time

A Projected Atlantic Flight.—The Minister of War, Dr Moreno, has informed Capt Zuloaga of the impossibility of the Government helping his projected flight from Puerto de Palos (Spain) to Buenos Aires on account of the lack of the necessary materials for carrying it out On account of this reply Capt Zuloaga went to the Ansaldo Co and asked them for the loan of a machine, having already obtained leave for the necessary time to carry out his project He is convinced that once having obtained the machine, a public subscription will be raised

Fast Mail Time.—On February 23rd the United States Mail Service broke all records for fast mail between San Francisco and New York City, when an airplane reached Mineola with seven pounds of mail The distance covered was over 2,700 miles and the actual time 33 hours and 20 minutes, or twice as fast as mail has ever been carried between the two cities by the air route Night flying made the record possible Jack Knight of Cheyenne, Wyo, carried the mail through the night, steering by compass, between Omaha and Chicago Although the route was new to him, he flew over the 1,000 mile course and landed safely

The Antwerp Airdrome.—Although some 1,200 passenger flights took place during the summer, and more than 100 passengers embarked at Antwerp for London or Paris, the Antwerp Airdrome has been closed and the airplanes and all material have been shipped back to Evère The 4th Military Flight Squadron is now in possession of the site With this blow to all energetic aviation enthusiasts in Belgium, more particularly to M Jean Olieslagers the devoted defender of Antwerp's air port, the projected Antwerp-Strasbourg line and the improvements in the British and French Air Mail, are now things of the past Its memory merely remains to show that the spirit of procrastination and the colossal lack of initiative and foresight prevails not less in Belgium than it does in other countries

The Stout Aerial Sedan is the outcome of the Stout monoplane which was designed during the latter part of the World War and for which great things were predicted The airplane is the design of W B Stout of Detroit, Mich It is fitted with one of the new 200-horsepower Packard airplane engines, and with this power plant carried a greater load at higher speed and for longer distances than any previous American built plane of twice the horsepower It is a real commercial three-passenger limousine, built entirely of veneer, including wings which are internally trussed and completely covered with veneer The plane is claimed to be nearly twice as strong as former types of airplanes, and yet weighs only 1,820 pounds Its maximum speed is in excess of 125 miles per hour while its landing speed is less than 45 miles per hour

Who Shall Work the Farms?—I

The Record of Last Year and the Prospects for 1921

By G. H. Dacy

AMERICA has a great habit of leaving its problems to solve themselves. We admit the existence of a grave question that presses for an answer; we discuss it in high places and get more or less widely worked up over it, we clamor for a legislative rubbing of the lamp of Aladdin which shall make the trouble magically fade into nothing; and then we go on about our business and leave it to chance and the slow natural working of the law of supply and demand to unravel the kinks. Sometimes this policy of letting things slide to a natural angle of repose works admirably. Sometimes, however, it leads to disaster, or close to disaster. Mr. Dacy has given a careful consideration to the farm-labor problem as it was revealed by 1920, and as a result of this is concerned to know where we are going to get our food supply in 1921—or perhaps, passing this year in safety, where it will come from in 1922, or in 1923. In the present article he establishes, we think, the serious character of the situation and the improbability of meeting it successfully by any of the obvious remedies. In a second article, in a later issue, he will attempt to put forward some constructive suggestions. — THE EDITOR

Where the overall movement finds its most practical application

ONE out of every four farm hands in the country has disappeared according to official reports of the Department of Agriculture, which show that the present supply of hired farm labor is 15 per cent less than last year and approximately 72 per cent of the normal supply. The chances are that the hired help deficit exceeds this figure as the Federal agricultural authorities are always very conservative and never circulate anything but the most conservative data relative to farming conditions. Without question the farm labor famine of 1920 was as serious as that of the summer of 1918.

The Secretary of Agriculture did all in his power to recruit the farm labor resources of the country and to mobilize the 24,000-odd students at the 48 agricultural colleges as well as the untold thousands of business and industrial workers—who rather than face a pronounced curtailment in food production were again ready to engage in emergency harvest work—for crop production and salvage work.

The Department addressed appeals to the various colleges, civic organizations, rotary clubs, commercial clubs and similar organizations urging them to lend all possible aid so that the American bread basket and meat hamper might be as full as ordinarily when cold weather again sets in.

"The farmers and their families will always exert every effort to maintain production," reported Secretary Meredith, "but they are without the hired help which they ordinarily have had. In consequence the food harvest may be measurably reduced unless others give assistance. Of course one with little or no farm experience should not expect to earn as much at first as a seasoned hand but in a few weeks practically all men and boys who are adaptable, alert and strong should be qualified to earn good wages in the harvest fields. The demand for farm labor has induced a considerable increase in the level of farm wages. This increase however does not permit the farmer employer to compete on equal terms with the industries, but a man or youth spending his summer on the farm is in position to save a larger proportion of his wages than if he were working in the city.

"Unquestionably there is manpower available in the schools, towns and cities sufficient to materially relieve the farm labor situation. I believe that men throughout the country at large will respond when they learn how critical are the conditions and so afford another practical demonstration of the neighborly and cooperative spirit which characterized the efforts of the people during the war. Many men have relatives or friends in the country to whom they can offer their services; others who are interested should write to the director of agricultural extension at their State agricultural college, stating the time at which they will be available and their qualifications. The director will put them in touch with county agents who know farmers in need of help."

Volunteer wheat threshers at Lexington, Ky.; the entire crop from 250 acres was threshed by volunteers

A Pennsylvania landlord and farmer who owns and operates more than 50 farms and who has been engaged in farming for over half a century told me that his solution of the farm labor shortage is greater field efficiency on the part of the available working forces and longer periods of service in the field. He spoke at length of one of his tenants who last year handled 500 acres of farming land with one additional man and a boy, a force which ordinarily was kept busy on one 200-acre farm. All the crops were saved because the men and boy worked as long as light lasted during the rush of the growing and harvesting seasons and also because good management was practiced in handling the place. "The trouble with farm labor—tenants as well as owners—is that they do not work so hard as they formerly did. Probably the national unrest and discontent apparent all over the world has also effected them," is the way this man sums up the situation.

On one of the best equipped farms in the country, a large place provided with every conceivable kind of modern labor-saving appliances, six tractors were harnessed daily from sunup to sunset trying to maintain normal cropping activities despite the paramount handicap of a limited labor supply. Two of these tractors have been operated by mere striplings, one a lad of ten years, the other a boy of fourteen, while the other implements in the battery have been manned by men. On an adjoining farm a boy barely eight years old daily throughout the season drove a four-horse team, riding one of the horses and harrowing and dragging the land as rapidly as his father and older brother could plow it.

One who traveled the Corn Belt and Middle Western States last summer saw unusual and interesting sights where the agricultural activities are the thickest. More field work was performed on Sunday than ever before—not that the farmers of that section desire to violate the solemnity of the Sabbath but because they appreciated that only by the intensive employment of every minute of available daylight would it be possible for them to plant, cultivate and harvest the maximum acreages which they would be able to handle with their restricted working forces. On nearly every farm it was a case of "work, work everywhere and only a few to do it." The unseasonable and late spring operated to increase the intricacy and complexity of the average farmer's problem of keeping pace with the calendar of his work.

It was common to see a boy driving one team—hitched to a drag for instance—and leading another team pulling a disk harrow or peg-tooth harrow. Every available tractor was worked to its limit daily, the double and tandem and triple hitches which permit of moving two or three different farm machines and of practically preparing a seedbed in a single passage of the outfit over the field were more popular than ever as means of combating the scarcity of man power. Commercial fertilizers—which permit of vitally increasing the acreage yield of the various staple crops—were purchased in large amounts despite their high prices. Farmers in general said: "We much curtail our cultivated acreage because we are shy on sufficient help but we will do our best to make the highest yields possible on the areas which we are able to crop."

The meager returns concerning the agricultural census which are available at this writing indicate that there has been a decided increase in the populations of towns and cities—especially in manufacturing and industrial sections—at the expense of the rural populations in the contiguous regions. The lure of shorter hours, proximity to the bright lights and higher wages have resulted in a marked exodus citywards from the country districts. Right now there are 25,000 idle farms in New York State. Alabama reports that 1,000,000 acres of fertile farming land which previously have been tilled are running rampant to weeds, filth and unproductive debility. The agricultural commissioners of Connecticut, Vermont, New Hampshire and Massachusetts announce 100,000 idle farms within their borders. Even Iowa—one of the richest, most progressive and reliable producers in the United States—shows a three per cent fa-

(*Continued on page 195*)

Old torpedo boats waiting in the marine junk-yard at Philadelphia to be refitted as fruit carriers, and the old British troopship "Terror"

Salvaging Torpedo Boats for Peaceful Uses

By William A. McGarry

A PRACTICAL use for the speedy little wasps of the sea that were considered the last word in torpedo boat construction twenty years ago, but are now outclassed, has been found at a Delaware River shipyard which is probably the largest marine junk shop in the world Thirteen destroyers named after famous American Naval heroes are now tied up at the docks of this plant, and five of them are being converted into cargo carriers and will go into service between Atlantic Coast and West Indian ports within a few months

Heretofore, when a torpedo boat reached the end of its value as a naval unit because of age or rapid developments in naval architecture, it was stripped of armament, instruments and machinery and tied up in some back channel to rust until sold for junk As a matter of fact, the thirteen destroyers now at the Delaware River yard were sold for their scrap value No one had ever succeeded in finding any commercial use for one of the narrow, fast little craft Attempts had been made to utilize them as yachts, but they were unsatisfactory as their hull lines were never drawn for comfort.

But now it has been determined that because of peculiar conditions existing in the fruit trade it has been found feasible to convert five of the destroyers for this service The average mean draft of the vessels in fighting trim was about six feet, and the length is from 245 to 260 feet with 23 to 25 feet breadth Armament was light from the viewpoint of the ordnance expert, but it ran into many tons Likewise, the machinery that gave the vessels their great speed filled the larger part of the space below decks

It has been estimated that with this machinery and armament removed it will be possible to load several hundred tons of miscellaneous freight into the hull space that will be available This tonnage is extremely small for a general freight carrying business, but in fruit it is expected to pay The idea is to eliminate the present heavy lighterage charge, to which virtually all the steamers of the existing fruit fleets are subject, by running the converted destroyers into streams and inlets right up to the plantation docks now reached only by the lighters In addition to the direct saving of labor thus attained, this will mean a considerable saving in loading time and will make possible a larger number of trips in any given period

The vessels will operate with a small crew Details of the machinery to be installed are not as yet available It will be based, however, on a power plant to consist of an oil burning engine of the Deisel type which will be located well aft, and which will take up relatively little space Since the boats are to be kept in coastwise service and the trips will be short, it will not be necessary to devote a great deal of space to the oil tanks. Yet it is believed that because of the slender lines of the boats relatively high speed will be possible, even with a light engine

It is likely that the eight boats remaining after the five are converted will be held until a thorough test is made of the practicability of the new plan If it proves successful the other boats will be put into the same service All of them are being stripped of their machinery, which is of no use except for high speed and is too expensive to operate The vessels in the group are the "Stewart," "Bainbridge," "Whipple," "Worden" and "Truxton," now being converted, and the "Perry," "Barry," "Dale," "Paul Jones," "Hull," "Lawrence," "Preble" and "Decatur"

The record of any of the thirteen boats is a lasting testimonial to the honesty of the builders and to the excellence of American Naval design and construction Reference to naval annals will show that the newest of the vessels is eighteen years old They were all built in the years from 1900 to 1902, yet until the close of the World War each was in active service One, the "Stewart," was the only American torpedo boat officially credited with sinking a German submarine In recognition of this feat the vessel was authorized to carry a gold star on one of her funnels Nearly all carried gold service strips when they were towed up the Delaware River from the League Island Navy yard and thrust their noses into the mud to await the hands of workmen

Every one who has read of the exploits of the torpedo boat in the World War knows that these craft are of the lightest possible construction - mere pliable shells of steel that seem to bend and give to every wave When the engines and boilers packed into the hulls from keel to deck plates are operating at top speed the vessels are shaken as a rat is shaken by a terrier These thirteen ships stood that sort of test off and on for fifteen to seventeen years, which is a fairly long life for a torpedo boat But just when they might have been retired America got into the war and it became necessary to use every ton of naval fighting force to guard the bridge of ships across the Atlantic

(Continued on page 196)

Copper in Steel and the Corrosion of Cars

By A. R. Surface

THERE has been for several years considerable controversy as to whether the presence of copper in small quantities in steel plates is a preventive of corrosion To determine whether results would be obtained in the bodies of steel railroad cars and their life prolonged, the Bessemer and Lake Erie Railroad early in 1914 ordered 100 hoppers and 100 gondola cars using both copper bearing and plain steel plates in the same car body

It would be impossible to make a true comparison of the two kinds of steel if placed in different cars, as no two cars are used under exactly the same conditions of service To make this test truly comparative, these cars were built so that the body of each car was made up of half copper bearing steel and half plain steel

These cars went into service in 1914 Considerable trouble has been experienced in locating them for inspection The first cars inspected after two years service showed that the paint on the outside of cars adhered much better on the copper bearing steel than on the plain steel This fact has been borne out by all subsequent inspections and at the end of six years is very noticeable, as will be seen by comparison of the illustrations showing the plain steel and the copper bearing steel plates in the same car As a result of the absence of the protective coating, the plain steel shows considerably more and deeper pitting on the outside of the cars

On the inside of the car, the copper-bearing steel was freer from adhering oxide or rust and less deeply pitted than the plain steel The accumulation of rust under the rivet heads showed that the loss in thickness was considerably greater on the plain steel than on the copper-bearing steel

On the outside of a car where the paint had come off recently, a pronounced difference was noted in the color of the exposed surface The plain steel was rough to the hand yellowish brown in color, while the copper-bearing steel was much smoother and of a dark reddish-brown color

The destruction of the body of a steel car is due to several causes, among which are mechanical abrasion or erosion, and corrosion

The character of the loads carried governs the destruction by mechanical abrasion, as there will not be as much abrasion with materials like ore earth or cinders as with hard, heavy materials such as pig iron steel blooms or billets Mechanical abrasion also has an effect on the corrosion, tending to increase the corrosion by wearing away the corroded surface and exposing a fresh metallic surface, which rusts more rapidly than a surface protected by dirt and a film of oxide or rust This explains why it was noted in the first inspections that the gondola cars were showing greater effect from erosion and corrosion than the hopper cars

The relative corrosion exhibited by plain steel and copper-bearing steel plates in the same car, after six years of service

From the Einstein Contest—III

An Introductory Statement of the Place Occupied by Relativity as a Phase of Human Thought

By "Conception" (Frank E. Law, Montclair, N. J.) and Others

MR LAW'S essay was early eliminated from consideration for the prize on the ground that it devoted too large a proportion of its space to introductory material. But it was clear from a first reading that as an introduction to the subject it was a performance of extraordinary merit, and one that we should certainly want to publish. We have avoided needless duplication by suppressing his concluding paragraphs, in which Mr. Law catalogs the consequences of Einstein's postulates. At the same time we have interpolated passages from other essays which throw additional light upon his discussion.

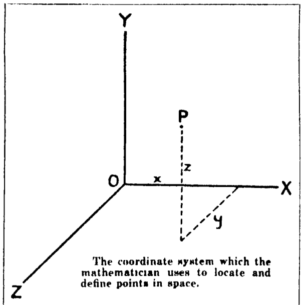
All that part of this text which is not enclosed within brackets is taken from Mr. Law's essay. The bracketed passages identified with an asterisk are supplied by the present commentator. Those abstracted from other essays are identified by the consecutive numbers attached to these essays on receipt in this office, these numbers are interpreted, and due credit assigned to Mr. Law's unintentional co-authors, below. We trust that the brackets, etc., will not unduly distract the eye of the reader, and that this style of composite essay will be found as profitable as it seems to us to be.—THE EINSTEIN EDITOR.

FROM a time beyond the dawn of history, mankind has been seeking to explain the universe. At first the effort did not concern itself further probably than to make a supposition as to what were the causes of the various phenomena presented to the senses. As knowledge increased, first by observation and later by experiment also, the ideas as to these causes passed progressively through three stages—the theological (the causes were thought to be spirits or gods), the metaphysical (the causes were thought in this secondary or intermediate stage to be some inherent, animating, energizing principles), and the scientific (the causes were finally thought of as simply mechanical, chemical, and magneto-electrical attractions and repulsions, qualities or characteristics of matter itself or of the thing of which matter is itself composed).

With increase of knowledge, and along with the inquiry as to the nature of causes, there arose an inquiry also as to what reality was. What was the essential nature of the stuff of which the universe was made, what was matter, what were things in themselves, what were the noumena (the realities) lying back of the phenomena (the appearances)? Gradually ideas explaining motion, force, and energy were developed. Matter was conceived as consisting of substances, compounds, elements, molecules, atoms, corpuscles, electrons. Contemporaneously with the inquiry as to the nature of matter, motion, force and energy, inquiry was made as to the nature of man, the workings of his mind, the nature of thought, the relation of his concepts (ideas) to his perceptions (knowledge gained through the senses) and the relations of both to the noumena (realities).

[The general direction taken by this inquiry has been that of a conflict between two schools of thought which we may characterize as those of absolutism and of relativism.]* [The ancient Greek philosophers believed that they could tap a source of knowledge pure and absolute by sitting down in a chair and reasoning about the nature of time and space, and the mechanism of the physical world.]²²¹ [Under this absolutist method a single observer is competent to examine a single phenomenon, and to write down the absolute law of nature by referring the results to his innate ideas of absolute qualities and states. The root of the word absolute signifies "taking away," and in its philosophical sense the word implies the ability of the mind to subtract away the properties or qualities from things and to consider these abstract qualities detached from the things: for example, to take away the coldness from ice, and to consider pure or abstract coldness apart from anything that is cold, or to take away motion from a moving body, and to consider pure action apart from anything that moves. This assumed power is based upon the Socratic theory of innate ideas. According to this theory the mind is endowed by nature with the absolute ideas of hardness, coldness, roundness, equality, motion and all other absolute qualities and states, and so does not have to learn them. Thus a Socratic philosopher could discuss pure or absolute being, absolute space and absolute time.]¹²¹

[The modern scientist has attained a very much more business-like point of view. To him a law is fundamentally nothing but a short-hand way of expressing the results of a large number of experiments in a single statement. And it is important to remember that this mere shortening of the description of a lot of diverse occurrences is by no means any real *explanation* of how and why they happened. In other words, the aim of science is not ultimately to *explain* but only to discover the relations that hold good among physical quantities and to embody all these relations in as few and as simple physical laws as possible.]²²¹ [This is inherently the method of relativism.]* [Under it a set of phenomena is observed. There are two or many observers and they write down their several findings. These are reviewed by a final observer or judge, who strains out the bias due to the different viewpoints of the original observers. He then writes down, not any absolute law of nature governing the observed phenomena, but a law as general as possible expressing their interrelations.]¹²¹ [And through this procedure modern science and philosophy reveal with increasing emphasis that we superimpose our human qualities on external nature to such an extent that it has been seriously asked whether the external world has any real or "absolute" existence outside our minds. Many of us have sought comfort in the thought that we possess geometrical axioms and mechanical laws as untainted by human sense-perceptions as pure mathematics. Intellects on other worlds should find them as immutable as we.]¹⁰⁶ [This conclusion is challenged when we carry relativity to its logical conclusions as Einstein has done.]*



The coordinate system which the mathematician uses to locate and define points in space.

From all this inquiry and criticism, which have gone on for centuries, has emerged the following present-day attitude of mind toward the sum total of our knowledge. The conceptual universe in our minds in some mysterious way parallels the real universe, but is totally unlike it. Our conceptions (ideas) of matter, molecules, atoms, corpuscles, electrons, the ether, motion, force, energy, space, and time stand in the same or similar relation to reality as the x's and y's of the mathematician do to the entities of his problem. Matter, molecules, atoms, corpuscles, electrons, the ether motion, force, energy, space, and time do not exist actually and really as we conceive them, nor do they have actually and really the qualities and characteristics with which we endow them. The concepts are simply representations of things outside ourselves, which things, while real, have an essential nature not known to us. Matter, molecules, atoms, corpuscles, electrons, the ether, motion, force, energy, space and time are merely devices, symbols, which enable us to reason about reality. They are parts of a conceptual mechanism in our minds which operates, or enables our minds to operate, in the same sequence of events as the sequence of phenomena in the external universe, so that when we perceive by our senses a group of phenomena in the external universe, we can reason out what result will flow from the interaction of the realities involved, and thus predict what the situation will be at a given stage in the sequence.

But while our conceptual universe has thus a mechanical aspect, we do not regard the real universe as mechanical in its nature. [This may be illustrated by a little story. Entering his friend's house, a gentleman is seized unawares from behind. He turns his head but sees nothing. His hat and coat are removed and deposited in their proper places by some invisible agent, seats and tables and refreshments appear in due time where they are required, all without any apparent cause. The visitor shivers with horror and asks his host for an explanation. He is then told that the ideas "order" and "regularity" are at work, and that it is they who acquit themselves so well of their tasks. These ideas cannot be seen nor felt nor seized nor weighed, they reveal their existence only by their thoughtful care for the welfare of mankind. I think the guest, coming home, will relate that his friend's house is haunted. The ghosts may be kind, benevolent, even useful, yet ghosts they are. Now in Newtonian mechanics, absolute space and absolute time and force and inertia and all the other apparatus, altogether imperceptible, appearing only at the proper time to make possible a proper building up of the theory, play the same mysterious part as the ideas "order" and "regularity" in my story. Classical mechanics is haunted.]¹¹⁶

[As a matter of fact, we realize this and do not allow ourselves to be imposed upon with regard to the true nature of these agencies.]* We use a mechanistic terminology and a mechanistic mode of reasoning only because we have found by experience that they facilitate our reasoning. They are the tools which we find produce results. They are adapted to our minds, but perhaps it would be better to say that our minds are so constructed as to render our conceptual universe necessarily mechanical in its aspect in order that our minds may reason at all. Two things antithetic are involved—subject (our perceiving mind which builds up concepts) and object (the external reality); and having neither complete nor absolute knowledge of either, we cannot affirm which is more truly to be said to be mechanistic in its nature, though we may suspect that really neither is. We no longer think of cause and effect as dictated by inherent necessity, we simply regard them as sequences in the routine of our sense-impressions of phenomena. In a word, we have at length grasped the idea that our notions of reality, at present at least, whatever they may become ultimately, are not absolute, but simply relative. We see, too, that we do not *explain* the universe, but only *describe* our perceptions of its contents.

The so-called laws of nature are simply

THE identification numbers found in the text mark passages from the essays submitted by the following contestants:

106—J Elias Fries, Fellow A. I. E. E , Birmingham, Ala.
116—Prof. Dr. J A. Schouten, Delft, Netherlands.
121—Elvyn F Burrill, Berkeley, Cal.
141—Dr M C Mott-Smith, Los Angeles, Cal.
216—Professor Andrew H. Patterson, University of North Carolina.
221—Walter van B. Roberts, Princeton University.
263—Professor William Benjamin Smith, Tulane University.
272—R. Bruce Lindsay, New Bedford, Mass.

statements of formulæ which resume or sum up the relationships and sequences of phenomena. Our effort is constantly to find formulæ which will describe the widest possible range of phenomena. As our knowledge increases, that is, as we perceive new phenomena, our laws or formulæ break down, that is, they fail to afford a description in brief terms of all of our perceptions. It is not that the old laws are untrue, but simply that they are not comprehensive enough to include all of our perceptions. The old laws are often particular or limiting instances of the new laws.

It is not strange that, confronted with the vast and bewildering complexity of the universe and the difficulty of keeping separate and distinct in our minds our perceptions and conceptions, we should at times and as respects certain things project our conceptions illegitimately into the perceptual universe and mistake them for perceptions. The most notable example perhaps of this projection has occurred in the case of space and time. The concepts of space and time are the most fundamental of all of our concepts They are the frame in which all else is set We got to think of them as absolute, as independent of each other and of all other things, and as always existing and continuing to exist whether or not we or anything else existed—space as a three-dimensional, uniform continuum, having the same properties in all directions, time as a one-dimensional, irreversible continuum, flowing in one direction It is difficult to get back to the idea that space and time so described and defined are concepts merely, for the idea of their absolute existence is ingrained in us as the result probably of long ancestral experience

The space of Galileo and Newton was conceived of as empty, except in so far as certain parts of it were occupied by matter Positions of bodies in this space were in general determined by reference to a system of three mutually perpendicular planes [The mathematician tells us very clearly how we may do this We pick out any point whatever in space and call it O. We then draw or conceive to be drawn through this point three mutually perpendicular lines called coordinate axes, which we may *designate* OX, OY and OZ, respectively. Finally, we consider the three planes also mutually perpendicular like the two walls and the floor of a room that meet in one common corner, which are formed by the lines OX and OY, OY and OZ, and OZ and OX, respectively. These three planes are called coordinate planes. And then any other point P in space can be represented with respect to O by its perpendicular distances from each of the three coordinate planes—the distances x, y, z in the figure These quantities are called the coordinates of the point][72] We find it possible so to choose our coordinate system that the great majority of the stars have, on the whole no motion with respect to it

[But it is clear that this empty space, in spite of the coordinate system which we have set up in it, is relative]* [This is not a difficult idea to grasp, and has been accepted in its rudimentary form for many years. The astronomer tells us that the particular spot of earth on which we happen to be standing at this moment and relatively to which we are describing our bodily movements, is being hurled through space relatively to the sun at the rate of approximately 18.5 miles per second The indication is that our sun is also moving relatively to the other stars, and for all we know these may be moving too,][75] [carrying with them any coordinate system which we may succeed in so adjusting that with respect to them it appears to be fixed. How shall we tell? How shall we attach to one coordinate system in empty space a unique position of preference over others?]* [The thought of such an absolutely fixed point in space as the O of such a system must be, becomes too much for the human brain to act sanely upon, and we fall back on relative space][72]

This space, and time, have always been conceived as independent of each other [For the concept of time has ever been one of the most absolute of all the *categories It is true that there is much of the* mysterious about time, and philosophers have spent much effort trying to clear up the mystery—with unsatisfactory results However, to most persons it has seemed possible to adopt an arbitrary measure or unit of duration and to say that this is absolute, independent of the state of the body or bodies on which it is used for practical purpose In other words, according to this view, time is not affected by conditions or motions in *space At first thought this seems to be a very reasona*ble hypothesis][72] [But it is one which we are now obliged to question -and, if we are to accept Einstein's theories, actually to deny

Before we come to this necessity, however, we must see how]* certain discoveries regarding *light* and the concepts formed to describe our perceptions *of light* called for a *modification of the empty space of Galileo* and Newton *Space under the wave theory* of light had to contain something to carry the waves, so it was conceived as filled with a medium which was called the ether This was conceived to be stationary and at rest and unaffected in any way by the motion of matter through it Space and time were still independent of each other This stationary and immovable ether rendered possible the idea of absolute motion, for planes of reference should possess absolute position in it

An experiment by Michelson and Morley introduced a great difficulty into this concept of the ether space The experiment was devised to determine the motion of the earth with respect to the ether Its procedure was to compare the time occupied by rays of light in moving forward along the path of the earth in its orbit, in moving backward along this path, and in moving perpendicular thereto—the distance covered being the same in each case Obviously these times, if the ether were stationary, would differ, for in the first case the source is overtaking the light, in the second it is moving away from the light, while in the third the velocity of the earth is not a factor one way or the other But it was found that there was no difference whatever in the time under the three conditions

[It seemed then that the ether of space must move along with the bodies on which the measurements were made But from our theories of light and electromagnetism, as will be made clear in more detail in a later essay, *if there is any ether at all, it must be at rest* relatively to all possible motion][7] The discovery of the new phenomena consequently entailed a modification in the concept of the ether space heretofore held New concepts had to be formed which would embrace the new perceptions as well as the old ones, and give a logical and consistent account of all the phenomena

[The contradiction involved is a very puzzling one and it gave physicists no end of trouble However *Lorentz and Fitzgerald finally put forward* an ingenious explanation, to the effect that the actual motion of the earth through the ether is balanced, as far as the ability of our measuring instruments is concerned,

(*Continued on page 196*)

Correspondence

The editors are not responsible for statements made in the correspondence column Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

The Great Divide

To the Editor of the SCIENTIFIC AMERICAN

As one of the goodly company who submitted essays in the Einstein Competition, may I through you offer my congratulations to the successful essayist, Mr Bolton

Perhaps many others would like to join in an expression of this kind "Many run but only one can carry the palm,' says the old Roman adage, and since it happens that the palm goes not to one of our own but to a runner from a foreign land, it is our privilege to more heartily recognize his victory

I have read the winning essay carefully, and while without knowledge of the merits of other essays, can readily concede that for directness, clear cut expression and firm grasp of subject, the essay is a fine piece of work Without undue elaboration, but with enough detail, with orderly and logical sequence, he has set forth the case It suggests the carefully prepared brief of a mind trained in the law.

Mr. Bolton has done what mathematicians often fail to accomplish, namely, express the reasoning back of mathematical processes, without recourse to symbols This is a gain, for often the symbol is regarded as the significant whole instead of a restricted part. So it happens that an equation may give results not found to hold in fact Like some surgical operations, which are regarded as successful from the surgeon's viewpoint, but from which the patient may not ultimately recover, so some mathematical operations are chiefly successful from the operator's point of view, and are not helpful to the investigator. Perhaps this is why Professor Eddington recently said "A mathematician is never so happy as when he does not know what he is talking about!" Let us modify this to read "Some of us are frequently made quite unhappy because we do not know what the mathematician is talking about." And some of us who have for a lifetime been compelled to watch equations, stretched, torn and tortured yes put upon the rack, and made to confess what really is *far from* the truth—well, we favor the formation of a Society for the Prevention of Cruelty to Equations

The successful essayist says that some things cannot be visualized Perhaps not as yet He says, too, it is not necessary "It is merely one of those irrelevancies to which those unaccustomed to think in symbols are liable" But when the time does come to use the symbol, let us carefully scrutinize the symbolization There can be no doubt that the essayist has set us a *good example, in not overloading his discussion with* formulæ

ALEXANDER MCADIE

Harvard University

To the Editor of the SCIENTIFIC AMERICAN

Since there were three hundred contestants for the Einstein essay prize, and since there was but one winner of it, it seems mathematically probable that 298 disgruntled competitors have already threatened to have *you hung* As we have *no designs on your life or* property we should object to being classed with such undue accelerators of the law But as defenders of more politely expressed indignation may we still be allowed to subscribe ourselves as The Two Hundred and Ninety Ninth?

Without access to the various essays which were rejected by the judges it is, of course, impossible to term their judgment wrong But is it really true that all the *other essays were as bad as that of Mr Bolton?* Is it conceivable—as they must have been— that they were even worse? Your intention, frequently set forth, was to give Mr Eugene Higgins' generous prize to the author of that essay which should most clearly and simply announce the Einstein theories of relativity Apparently you found an essay which, to you, seemed to satisfy those admirable conditions For the work of Mr Bolton was not only finally selected over the heads of *many* other essays: when you printed it you expressed a disbelief that "it would be possible to make any material improvement upon Mr Bolton's selection of the ground to be covered in an essay of this character." More, you said that "everybody will of course agree that he says admirably what he has to say"

We shall take up little of your valuable space We shall confine ourselves to the question, What do you mean by "an essay of this character"? for the answer to that question is the whole root of our reason for disagreeing flatly with your belief that he says admirably what he has to say We maintain that he says it abominably

Technicalities are ruled out The manner here is the whole matter The principles of relativity are simply to be elucidated, made clear in easy English for the average non technical reader to see and understand And what do we find? Blithe references to "coordinates," "continuums," "graphs," "frames of reference," "Euclidean propositions" and the like, a brief exposition of the theories of Karl Gauss in the statement *that "all Gaussian systems are equivalent* for the statement of general physical laws", and, finally as a general introduction to a mass of badly phrased facts—as a topic sentence in which one at least expects a little beguiling optical ease—the world is met with the following masterpiece to crack its head and hopes against "The reader is probably acquainted with the method of specifying positions of points in a plane by their distances from two mutually perpendicular lines, or if the points are in space by their distances from three mutually perpendicular planes like adjacent sides of a flat sided box"

As a patent expert Mr Bolton undoubtedly knows his business, as editors you undoubtedly know yours, and perhaps we will be told to mind our own But we cannot refrain from entering a protest against what we consider a gross miscarriage of common sense under the terms and articles of the contest

We entered that contest We lost the prize And we are quite satisfied that we lost it fairly We nevertheless insist that even the readers of your magazine are probably not widely acquainted with the method of specifying positions of points in a plane by their distances from two perpendicular lines, especially when a simple geometric proposition is couched in such unnecessarily bewildering language And so we say that if the rest of the essays were as bad as "Zodinque's" it would have been fairer to the world for the judges to have withheld the prize entirely and to have announced regretfully that the competition had resulted in a stalemate of stupidity As a Parthian shot, may we express regret that Mr Bolton was more successful in practising one of the Gaussian theories than he was in elucidating any of them? We mean the Gaussian Theory of Least Constraint

MALCOLM K PARKHURST,
WINTHROP PARKHURST

New York City

Textile mill (left) and candy factory (right) which depend for a satisfactory product upon scientific control of temperature and moisture content of the air

Making Weather to Order

The Indoor Meteorology That Makes All the Difference Between Industrial Success and Failure

By Harry A. Mount

THE effect of weather on all human activities is so tremendous that men have been trying, since time immemorable, to control it in some degree. The fellow who tried (and is still trying) to make the rain pour or to cease pouring at his command, found that he had a rather large order on his hands, and our great food crops are still at the mercy of the elements. But not so with the manufacturer, to whom weather is just as important as it is to the farmer. He has found a solution of his weather problem.

Most manufacturing processes are carried on within the protection of four walls and a roof. Why not condition the air within that enclosure to suit the need, regardless of outside conditions? And conditioning here *means controlling not only the temperature of the air*, but also its purity (cleanliness), and its humidity or moisture content. This can be and is being successfully done. The fact is, or ought to be, of great importance to nearly every industry in the land, for weather "manufactured to order" assists in solving a myriad of problems which at first seem to have little or no relation to it.

For instance, in the textile industries it is possible to speed up machines and workers alike and at the same time to lessen the hardships imposed on both, simply by the use of manufactured atmosphere. A textile fiber is like a sponge in its affinity for water, and it takes all it can from the surrounding air. If it becomes too moist it loses strength and breaks easily. If it is too dry it becomes brittle and snaps during the spinning and weaving. If the humidity of the air is carefully controlled the machinery can be speeded up with less breakage of yarns. In most textile mills hundreds of machines and workers are crowded into a single room. The heat from the machines, even in winter, becomes almost unbearable and investigators have blamed much labor trouble on this condition. In speeding up the machines by air conditioning the work rooms are kept in a comfortable state and it is found in actual practise that the workers speed up along with the machines and are more contented.

It has come to be recognized that the most important factor in conditioning air, whether it be for human comfort or to aid in a manufacturing process, is to control the humidity. Failure of the early experimenters to do this economically has delayed for so long this apparently simple development.

One of the early fallacies was attempting to raise the humidity of the air by atomizing water directly into the atmosphere. But a lot of heat is required to vaporize water. One engineer has shown that if the heat required to vaporize one pound of water were turned into mechanical energy it would lift a 150 pound man from sea level to the top of a mountain five thousand feet high. This method, obviously, is uncertain, extremely difficult to control, non-uniform in result, and dangerous to fine machinery because free water is often deposited.

The modern engineer takes advantage of the natural tendency of air to absorb all the moisture it can hold. He simply supplies the moisture in a form which the air can most readily absorb—as a fine spray. Humidity, it ought to be explained, is a relative term. The amount of moisture which the air can hold depends on its temperature and air which is "dry" at one temperature may be "wet" at another, although the actual moisture content has not changed. Thus in winter if we take air from the outside of our home, supposing it is saturated, that is it contains all the water it will hold at that temperature, and heat it to 70 degrees it would then contain only one sixteenth of the moisture it could hold at its new temperature. Thus without changing the actual moisture content, we would have turned wet air into very dry air and it begins absorbing moisture from every possible source, even from the furniture and woodwork. For this reason humidity, by which is commonly meant "relative humidity," is expressed in percentages. Thus air with a humidity of 50 per cent holds but half as much water as it could at its given temperature, if it were saturated.

It will be seen that to reduce the relative humidity of the air in winter one has simply to heat it. In summer refrigerating apparatus is provided to cool the water spray through which the air is drawn. As the air enters the thick cloud of spray it is chilled and part of the moisture condenses and is carried away by the falling spray. By controlling the temperature of the spray with respect to the temperature of the outside air the humidity can be very closely controlled. For adding humidity to the air the reverse process is carried out. When relatively dry air is drawn through a warm spray it picks up moisture.

One might imagine from the foregoing that while an air conditioning machine is very simple, it would require constant attention from a trained engineer to maintain a given air condition within a building. As a matter of fact the machine itself is more complicated and has in addition to the spraying apparatus a series of inlet baffle plates to distribute the air passing through *the machine and a set of eliminator* plates through which the air passes after leaving the spray, which collect all excess moisture that might otherwise be carried as fine spray by the mere velocity of the air. There is also heating or refrigerating machinery, according to the effect desired, and a carefully designed duct system for distributing the air. As for the operating engineer, his work is done by two or three strategically placed thermostats or hydrostats, which maintain any given air condition day and night for an indefinite time, without attention.

In the design of a duct system the engineer is put to the test, for no matter how well the conditioning machine does its work, the air will be useless unless properly distributed. Each installation is a separate problem and must be calculated to a nicety, taking into consideration the size and shape of the air ducts, their placing, size of the outlets and the velocity of the air as it leaves them, avoidance of draughts, etc.

Another principle of nature is taken advantage of where cool and moist air is needed in summer: this is the cooling effect of evaporation. When partially saturated air is passed through water-vapor it becomes saturated, and in doing so gives up some of its heat passing into the room perceptibly cooler. The drier the warm air outside the greater is the cooling effect. Thus in a textile mill in Boston where this plan is utilized a cooling effect of from 20 to 25 degrees below the outside temperature is often attained. Another installation, nearly identical, delivers the inside air from 25 to 30 degrees cooler than that outside.

Of course the textile mill is but one example of hundreds of industries which are making profitable use of manufactured weather. One of the reasons the bread you buy from a large baking house is uniformly good is because it is raised in rooms where the weather is always right for bread making. The old time baker had to guess when his dough was

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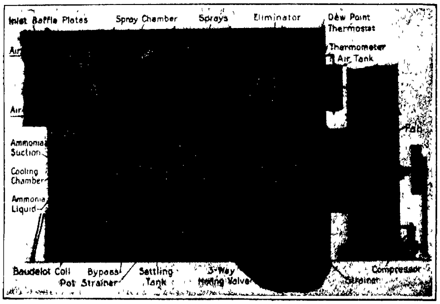


Dehumidifier with dew-point control, showing the main parts of the controlling mechanism

A Bar-Bending Machine from a Discarded Steam Shovel

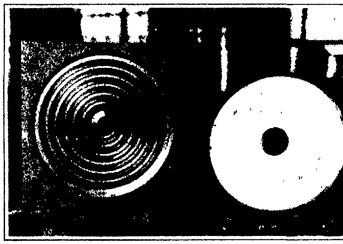
How a collection of steam-shovel parts was assembled by an ingenious contractor to make a powerful reinforcing rod bender

ONE of the largest engineering problems being solved by this country at present is the Industrial Canal and Inner Harbor, being built at New Orleans. The country through which the canal will pass is beneath the sea level, and a creek, or drainage canal, crosses the line of the Industrial Canal. Concrete is being laid upon a foundation made of thousands of wooden piles and steel reinforcing The drainage canal is made to pass through a siphon, directly under the ship canal, so as to prevent any change in the level of the latter. Huge locks, which engineers on the work claim are more difficult to construct than those of the Panama, are being built above this same mud and quicksand foundation The details of this work were recently covered in these columns

Now for the reinforcing of the concrete used in these locks, it is necessary to change the form in order to meet various circumstances, and it is for the purpose of bending the iron bars into any desired shape that the machine, shown in the accompanying illustration, is used. It will be noted that the parts for this machine could be readily located on any large engineering project It consists of a large table, made of heavy wooden sections, securely bolted together and having the upper surface covered by a piece of sheet steel The bar to be bent is placed over the guide rails, which have been built of heavy pipe and are placed at both ends of the table The particular part to be bent is placed between the collar and a dog, both of which are made part of the large geared revolving member The action is produced by an air cylinder which drives a rack, geared to the rotary or bending member The air pressure is regulated by a valve and the bars may therefore be bent at any desired speed Bends of any description may be obtained by simply changing the size of the collar and the location of the dogs

It is interesting to note that the parts for this bending machine have been recruited from the remains of a discarded steam shovel, and that the work they do is not at all in line with that for which they were built The size of the rod which is being bent is 1 3/4 inches in diameter The bending is done while the bars are cold—and done with the utmost ease

Welding Where Casting Fails



First and last stages in preparing steam-heated brass platens by the welding process

THE first and last stages of an interesting and unusual application of welding are illustrated in the accompanying photographs This work was performed for a firm manufacturing hydraulic machinery, and was intended for filling a contract calling for steam-heated brass platens for the curing of phonograph records

After trying a number of methods of making the necessary steam passages in castings by the use of cores, it became evident that satisfactory castings could not be produced by this method They could not be made impervious to the steam Accordingly, a new line of procedure was undertaken, to wit In a solid rolled-brass plate (1½ inches thick by 14 inches square) concentric grooves were turned to a depth sufficient to give the necessary steam capacity The whole working face of the plate (12 inches diameter) was also cut away to a depth of ⅜ inch except for a central boss, to accommodate a cover plate which was to be welded to the central boss and to the outer circumference of the undercut This central boss and the outer circumference of the undercut were champfered away in the manner usual for preparing an edge to edge weld The circular cover was then prepared with the edges beveled in the same manner, leaving the usual trough for welding A specially prepared clamping jig was then affixed to prevent warping, due to contractional strains, and the entire job was preheated, the welding done in the usual way, and the plates allowed to cool slowly in the fire As a result of the annealing all contractional strains were satisfactorily eliminated

The final operation was performed by facing off the plate in a lathe, and the work was so well done that it was barely possible to discover the joints The plates have given complete satisfaction in service

Casting a 60,000 H. P. Hydraulic Turbine

SOME remarkable casting work has been done in connection with the building of six hydraulic turbines each of not less than 60,000 horsepower capacity, for the Hydroelectric Power Commission of Ontario These units will be installed at Niagara Falls

The spiral casing of the 60,000-horsepower hydraulic turbine is a gigantic piece of apparatus The inlet diameter is 10 feet, and the distance across the casing at the widest part is about 38 feet From center to the extreme edge of the inlet flange is 22 feet The casing is made in nine sections, and in order to insure the accurate casting of these sections a skeleton pattern for the entire casing was first built as shown in our cover illustration, and then separated into nine sections

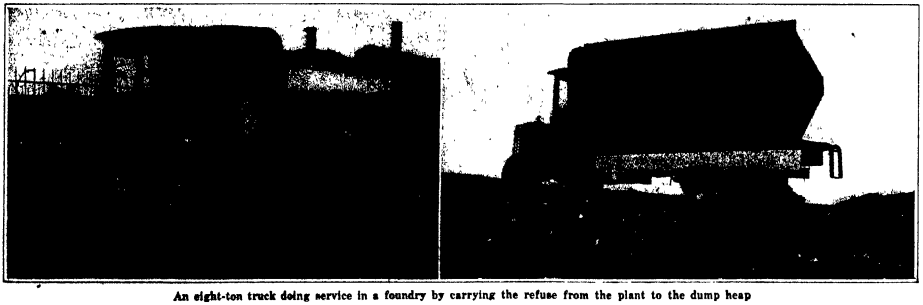
In order to secure castings that would safely withstand the enormous hydraulic pressure, the various sections were cast on end so that all impurities would float into the risers leaving the metal absolutely sound Once completed, the castings were bolted together with the speed ring or member which fits inside the spiral, and subjected to a severe water pressure test far in excess of the normal working pressure

Soldering Zinc

IN soldering zinc, the surfaces should be carefully cleaned as in the case of any metal and the ordinary acid soldering flux used in soldering galvanized iron may be used The ordinary half and half solder is satisfactory and a moderately hot iron is best The solder should be applied while the surfaces are still moist with the flux and the iron should not become red hot or kept in contact with the zinc longer than necessary to give a good joint One quick pass is usually enough and if the iron is too hot the metal may be melted and is almost sure to be weakened

Expediting Handling of Foundry Refuse

A LARGE foundry located at Albion, Mich., has recently introduced a motor truck and a special railway for handling its refuse, and the results are said to be highly satisfactory The motor truck in this instance is of 8 ton capacity, equipped with flanged wheels and a special dump body, as shown in the two accompanying illustrations The truck operates on a short length of track extending from the foundry to the dump heap The foundry officials state that the installation of this truck and railway has taken the place of three teams and seven men in handling refuse to say nothing of taking care of it more expeditiously



An eight-ton truck doing service in a foundry by carrying the refuse from the plant to the dump heap

Air Plus Oil Equals More Oil

How Compressed Air Takes the Place of Natural Gas in Stimulating the Flow of Old Wells

By Robert G. Skerrett

THE possible exhaustion of our pools of petroleum is no longer a matter merely for the speculation of technicists. It touches all of us sooner or later, no matter whether we live in the rural districts or in the densely populated cities. Aside from petroleum's part in providing motive energy, something that coal does on a much grander scale, the wheels of industry would become sluggish and even stop if they lacked a sufficiency of lubricants. It is from petroleum that we get the greatest measure of our lubricating oil and a plenty of this we must have whether the primary source of power be water, coal or oil.

As the situation stands today in the domestic oil industry, we are virtually living from hand to mouth, and the demand is becoming harder to meet despite everything that is done to augment production. "In September of 1920, as in August, the daily output of the United States oil wells was slightly over 1¼ million barrels, but the daily consumption rose to 1⅝ million barrels. This daily deficit of ⅜ of a million barrels was met by imports from Mexico. To this extent, then, we are already dependent upon a foreign supply of oil."

That we must rely less upon petroleum for motive purposes and more upon the burning of coal and the utilization of our falling waters is inevitable. The same eminent authority just quoted has made this clear by citing the utmost possibilities of our natural power resources. For instance, if the entire load of our present power requirements were carried by steam plants using coal, our mines would be able to tide us along for a period of 57,000 years. Whereas if fuel oil were substituted for coal for the same service our billions of barrels of reserves under ground would last for only 9¼ years.

Again we learn that if no more oil wells were drilled for a year our production would fall off from 25 to 35 per cent. Therefore, each twelvemonth it is necessary to drill new wells and to find fresh fields of supply, and just where these may lie is not known at any time with certainty. Only by ceaseless and expensive exploration is it possible to prevent a day of serious shortage. With 40 per cent of our original store of petroleum exhausted, the near future bristles with difficulties. Yet the outlook is really better than at first blush it seems, thanks to work that is being done in various direction, of which the general public knows little.

Time and again we have been told that the prevailing methods of extraction are quite incapable of recovering from the oil-bearing sands more than 20 per cent of the petroleum hidden away in the subterranean pools. Accordingly, man's ingenuity has been spurred on to devise ways by which a greater measure of this natural bounty can be obtained, and in this quest the scientist and the engineer have collaborated with heartening success. As a matter of fact many old and abandoned properties have been given a new lease of life, and amazing quantities of oil have been withdrawn from sands apparently drained or rapidly nearing the end of their yield.

Broadly stated, there are many reasons for believing that the capacities of the oil sands in the different fields in this country are anywhere from five to ten times greater than the quantities of oil usually realized from them. The failure to obtain a larger measure of the petroleum is principally due to the dissipation of the natural gas following the driving of a well. The velocity with which this gas is known to escape is a fair index of the pressure under which it has been stored beneath the overlying rock which for ages has held the gas confined. This pressure not infrequently reaches a thousand pounds and more a square inch; and the oil is charged with this gas much after the fashion of the contents of a bottle of soda water.

When the oil prospector drives his well he taps a virtually sealed reservoir. Instantly the pent-up petroleum is offered an avenue of escape, and the expanding gas serves to force the oil surfaceward. This explains the action which takes place at spouters, and so long as the oil flows naturally the movement is due to the impulse imparted by the gas. Of course, the oil may still come above ground through gravitation if there are hydrostatic conditions that provide a sufficient head. But, normally, pumping is relied upon to lift the deep-seated oil after the gas pressure drops to the point where it will no longer help.

It seems perfectly logical, under the circumstances, that the fertile-minded should suggest a partial replacement, at least, of the original gas pressure, achieving this artificially by using air forced down by suitable compressors. Despite the skepticism that has belittled the value of this procedure, the Federal authorities have latterly announced that on many old properties in the eastern fields this application of compressed air has increased the recovery of petroleum variously from 50 to 100 per cent.

Ten years ago, out in Ohio, I. L. Dunn, profiting by an earlier experiment, decided to see if he could not boost up the output of property on which the wells had dropped to an average of 7 gallons of oil daily. Selecting an abandoned well for his test, he forced into it for about a week 150,000 cubic feet of free air every twenty-four hours at a pressure of 40 pounds. At the end of that time the production of the surrounding wells was raised something like 70 per cent. Here the oil-bearing sand was of a coarse and pebbly character; in short was such as to facilitate the flow of the petroleum under the impulse of the compressed air.

Subsequently, within an interval of five years, the process was resorted to on fully 90 properties, and four-fifths of these efforts amply justified the outlay. The wells involved numbered around 4,000; and substantially all of them lay in the fields of southeastern Ohio and the northwestern section of West Virginia. In the interval that has followed, the adoption of the method has gradually widened, and certain improvements have been developed as the result of riper experience. Further, it is now realized that commercial success in any region is contingent upon the nature of the oil sands, the associated geological conditions, and the manner and extent to which the field has already been worked.

The method commonly pursued in the so-called Marietta process—thus known because it was first tried out near the town of that name in Ohio—consists fundamentally in forcing air through selected wells into

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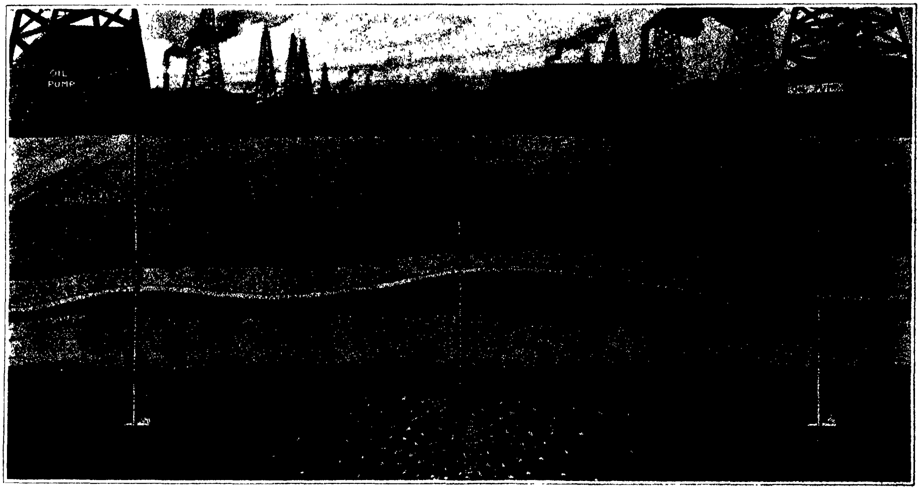


Compressed air is pumped in to make good the diminished natural-gas pressure. The air is pumped down a shaft that is used for this purpose alone, being definitely abandoned as an oil producer. It serves to force the oil away from the zone of air pressure about the foot of the air shaft and toward the intakes of the oil pumps, *the overlying rock formation acting as an imprisoning barrier above the air*

Diagrammatic representation of the Marietta process for restoring the flow of exhausted or nearly exhausted oil-wells

Trumpeter swans of the recently discovered colony in British Columbia

The Papaya, or Tree Melon

By Dr. Wm. A. Murrill, New York Botanical Garden

THIS is one of the most delicious of all tropical fruits and the tree on which it grows is noted for its beauty and productiveness In the Hawaiian Islands, the papaya ranks next to the banana in popularity, while in Mexico, Cuba, and Jamaica I have found it to be a common and much esteemed article of diet From its original home in Central America, the tree has been carried to all parts of the tropics, being able to pass the winter in the open as far north as Jacksonville, Florida, and the southern part of California

The common name, papaya, is a corruption of the Carib word *ababai*, while the scientific name, *Carica Papaya*, is derived from the same source and from a supposed resemblance to the fruit of figs Papaya is preferable to papaw, because the latter term is also applied to a small tree growing along streams in the southeastern United States, bearing small yellow, oblong fruits that taste somewhat like an overripe musk melon

The papaya tree is small and shapely, resembling a palm, having a single slender trunk surmounted by a cluster of large leaves, while the conspicuous melon-like fruits cling closely to the stem below It grows to a height of from ten to thirty feet in cultivation but in the wild state may reach sixty or a hundred feet The wood is of no value whatever, being so soft and spongy that it can be cut like a potato, and in young trees there is little more than a large central cavity surrounded by pith

The leaves are about two feet across, deeply lobed, with long stalks and fall off early, leaving large scars on the trunk The flowers are of two kinds, male and female, usually borne on different trees The former are funnel-shaped, one inch long, five lobed, white or yellow, and borne in drooping clusters a yard in length The female flowers, which give rise to the fruit, are considerably larger, usually yellow, or rarely purple, and are situated in the axils of the upper leaves

The fruit is much like a melon, being oblong or rounded, yellow or orange when ripe, three to twenty inches long, and weighing at times as much as twenty pounds On being cut open, a large cavity appears containing wrinkled, blackish seeds the size of small peas The orange-yellow flesh, one to two inches thick, is sweet and refreshing in the best varieties, but may be insipid in others I found it agreeable from the first, but some have to acquire a taste for it There are great differences in the size, shape, and quality of the fruits grown in different regions and under different conditions Of the numerous varieties in cultivation, the one in which the leaves are more or less violet-colored is very highly esteemed

The fruit is considered very nutritious and wholesome, either in the fresh state or cooked, provided it is thoroughly ripe It is commonly used in the tropics for breakfast as we use melons, with the addition of sugar, lemon juice, or salt and pepper, as preferred It is also served with sugar and whipped cream as a dessert, with lettuce as a salad, or with water, eggs, and milk in the form of a sherbet Stewed papaya is eaten plain or in pies, custards, and crystallized shapes, while preserves, jellies, and pickles are also made of it. Even the seeds are eaten, being aromatic and pungent like watercress

The green fruit is often cooked as a vegetable, resembling squash It is peeled, sliced, mashed in cold water, which is frequently changed to remove the acrid juice, and then cooked quickly in boiling water The bark is used for ropes and the leaves for soap and for removing stains from clothing Slices of the ripe fruit make an excellent cosmetic for the face and other parts of the body, removing warts, pimples, and discolorations, and healing boils and sores All parts of the plant, as well as the fruit, exude a milky juice containing papain, an enzyme which promotes digestion like the pepsin secreted by the glands of the stomach If meat is rubbed with this juice, or cooked with the fruit or wrapped in the leaves for several hours, it becomes tender, which is a great aid to digestion in warm countries where flesh must ordinarily be eaten as soon as the animal is killed It is impossible to estimate how many lives the papaya may have saved in this way or how many it may have prolonged and gladdened

Papaya trees must have plenty of space and sunshine This is why they never form thickets but only clumps at best When clearings are made in the tropical for

(*Continued on page 200*)

The Trumpeter Swan

By T. M. Fraser

AMONG the water fowl long considered extinct in nearly all parts of the North American continent, and certainly extinct in many parts where it formerly had its habitat, is *Cygnus buccinator*, the trumpeter swan This, the largest of the swan kind, and the largest of the water birds known to have existed in North America, was always an easy mark for the sportsman, and although only the young fowl were agreeable to the cultured palate, the Indians slaughtered and ate young and old indiscriminately The result was that, although at one time extremely plentiful, particularly in Canada, where their breeding range extended from the Rockies to the western shore of Hudson Bay and from latitude 60 degrees to the Arctic, they were finally practically wiped out like the passenger pigeon and the buffalo It was with peculiar interest, then, that at the recent annual meeting at Ottawa of the International Association of Fish, Game, and Conservation Commissioners, those present learned that a large colony of trumpeters had been located on a lake in the interior of British Columbia, where they have been breeding

Observations vary as to the last appearance of these fowl in the United States As far back as 1884 they were found only in small numbers in California, where they had once been extraordinarily plentiful There were occasional reports of their appearance in different parts of the United States up to 1893, but they were not confirmed as genuine The Canadian Government naturalists, the Messrs Macoun, in their report published in 1909, recorded that several nests of trumpeters had been found by a Canadian Government explorer in the barren grounds on the islands in Franklin Bay and on the beach there a nest was taken with six eggs In 1891, a nest was found at Buffalo Lake, Alberta It was three feet in diameter, composed of sods grass and rushes, lined with feathers and down

Up to the 1850's the trumpeter swan was more or less common, and McFarlane the Canadian naturalist says that between 1853 and 1877 the Hudson Bay Company in Canada sold 17,671 swan skins the num

(*Continued on page 200*)

From left to right, the views show: male (above) and female (below) flowers of the papaya a papaya orchard, a grafted tree in fruit, and a fine type of the seedling fruit, reaching ten inches or more in length

The papaya, a little known edible fruit, and how it grows

The Heavens in March, 1921

The American Association of Variable Star Observers and Its Work

By Professor Raymond Smith Dugan, Ph.D.

IN the absence of Dr. Russell, who has gone to England for the conferring of his Royal Society Medal, we present this month his colleague in the Department of Astronomy at Princeton, Dr Dugan—a most acceptable substitute —THE EDITOR.

THOSE who read the monthly articles on astronomy will be interested in the purposes and achievements of the American Association of Variable Star Observers

The peculiar importance of this banding together of amateur astronomers lies in their recognition of the fact that they are well able to carry on as important a line of research as any that is being followed at the observatories of the country, and their assumption of a large part of the responsibility for the continued observation of the long period variable stars

Interest in a mild form of astronomy is quite wide spread Most people have taken the trouble to learn to recognize a few of the constellations, and accept eagerly an invitation to have a look through a telescope A good many people have read of and tried to understand the method by which the diameter of Betelgeuse was measured A few boys buy small telescopes or make telescopes themselves or rig up cameras to photograph the sky Here and there is a man who has kept his telescope takes it out in his backyard on an occasional evening for a look at Jupiter, Saturn and a few of the nebulæ and double stars, and sometimes thinks to himself that if things had worked out differently he might have become an astronomer in a big observatory where all the discoveries are made and the big problems of the universe brought nearer to solution, or, if only he had lived a few hundred years ago when the three inch telescope was a big telescope he might have had a chance to make some observations of value

Desiring to benefit such potential observers and inspire many more by suggesting to them a program of serious observation, and at the same time hoping to build up an organization which would gladly take up the observation of the much neglected long period variables, seven enthusiastic observers of variable stars *founded the nucleus of the association in 1911* The late Professor Pickering offered to furnish the organization with charts of the regions containing the variables, and Professor H C Wilson offered the columns of *Popular Astronomy* for the publication of the observations Mr W T Alcott offered his services as secretary, writing to those already interested and inducing others to become observers That he found some remarkably fine observers hidden away there is little doubt From a start of seven members, the number has gradually increased to over two hundred The association has accumulated over 110,000 observations in the past nine years and is following nearly 500 variable stars Observers have been found in Japan, Siam, India, Italy, Spain, France, England and South America who are willing to join in the work, so that the association is able to keep a watch, when necessary, on the whole sky throughout the whole twenty-four hours

In 1917, after the Association had proved its worth and felt that it would stay together, it was formally organized and incorporated under the laws of Massachusetts and took its place among the astronomical societies of the world

The Association has a collection of nearly 500 slides which is available for loan to any of its members It also has under its control some twenty telescopes which are loaned to deserving members who wish to improve their working conditions Through the generosity of one of the members the Association is prepared to award a medal to any member who is the first to discover a Nova

The vocations of the members are certainly varied, clergymen, students, lawyers, farmers, doctors, teachers, reporters and bankers are included in the ranks Many more observers are needed There are a great many long period variables known and many more will be discovered The brightness of many of these variables makes their observation easy with small telescopes, in some cases even with a field glass or with the naked eye Their slowness of variation makes it possible for the observer to work at his convenience and their great range of variation makes them interesting The causes of their variation are not known and cannot be known until many more observations have been made Skill in observation of variable stars is readily acquired by one gifted with patience The Association also needs many more telescopes and their gift or loan would be much appreciated That they will be put to good use is assured

Two Nebulæ with Unparalleled Velocities

Professor Slipher states that recent observations at Lowell Observatory with the nebular spectograph have shown that the nebulæ N G C 584 and N. G C 936, both evidently of the spiral family possess much the highest velocities yet observed for any objects Exposure of 28 hours and 34 hours, respectively, were required to secure serviceable spectra The displacements of the spectrum lines are toward the red in both cases and correspond to the exceptional velocities of 1,800 and 1,300 km/sec , respectively The motion is in each case away from the sun The radial velocities of spiral nebulæ heretofore observed average about 400 km/sec Eleven of the nineteen gaseous nebulæ in the Greater Magellanic Cloud are receding at velocities ranging from 237 to 287 km/sec and about 150 km/sec is the average radial velocity of the Globular Clusters The velocity of the sun is about 18 km/sec

The Heavens

The bright winter constellations and the Milky Way, which lies roughly parallel to them, have swung around, pivoting at the north, and have taken up a position nearly parallel to the western horizon from Cassiopeia nearly in the north through Perseus in the northwest, Taurus in the west, and Orion a little to the south of west to Canis Major in the southwest Leo, looking like a sickle, is high up on the meridian The Great Bear is about the same distance to the north of the zenith with the dipper upside down Gemini is about half way from the zenith to Orion, and Auriga is to the west of Ursa Major Procyon can be found with the aid of the knowledge that it forms a fairly good equilateral triangle with Sirius and Betelgeuse. The handle of the dipper points roughly to Corona Borealis in the east Looking toward the east one sees Spica in the southeast in a region devoid of other bright stars, and Arcturus nearer east and at about the same altitude Vega is just appearing above the horizon in the northeast. The Autumnal Equinox is about two fifths the way on a line from Spica to Regulus.

Sun, Moon and Planets

In latitude N 40° the sun rises on March 1 and 31 at 6 45 and 5·47 and sets at 5 50 and 6 22, respectively, all times being Local Mean The corresponding standard time may be found by adding to or subtracting your longitude from the standard meridian, according as you are to the west or east of it The sun crosses the celestial equator from the south to the north side on March 20 just before midnight eastern standard time, bringing spring with it The mean sun, whose distance from the meridian is indicated by our clocks—at least the good ones—will then be about 1¾ degrees to the west of the true sun and will not arrive at the Vernal Equinox until the evening of the 22nd.

The moon is new on the 9th and full on the 23rd The next Sunday, March 27, will be Easter Sunday

Mercury reaches greatest western elongation on the 29th, but is still low in the east at sunrise

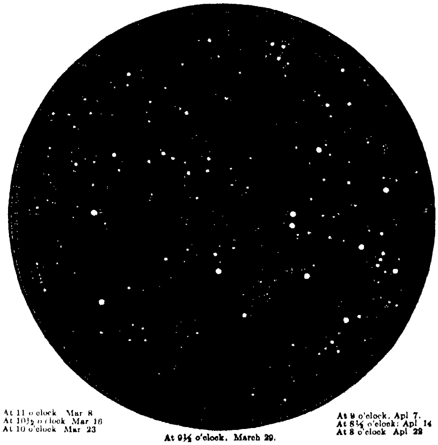
Venus is an evening star and has started back toward the sun The phase becomes more and more crescent and the apparent diameter increases from 30" to 48" During the early part of the month a large component of the motion of Venus is toward the earth and it moves eastward from Pisces into Aries As the *planet swings in toward inferior conjunction the component* of its motion parallel to the earth's motion increases until it is equal to the latter on the 31st, at which time the planet ceases its eastward motion among the stars, and at once starts to "retrograde" On March 16, or at about half the interval from greatest elongation to *inferior conjunction, it attains* its maximum brilliancy of magnitude —4 3, or about 100 times that of Sirius The brightness of Venus in the daytime is always surprising to those who see it then The only difficulty lies in looking in the right direction She crosses the meridian at about 3 P M on the first of March and about 2 P M at the end of the month One should look south and high up about 20° from the zenith The crescent moon and Venus less than 6° apart will make a pretty sight on the 12th

Mars is being gained on slowly by the sun. At the end of the month they are only 1h 35m apart Mars is far around its orbit on the other side of the sun and getting fainter

Jupiter retrogrades during the month from about 15° to about 12° east of Regulus, and is at maximum brilliancy It is in opposition, and therefore nearest the earth on March 4, when it crosses the meridian at midnight Its apparent diameter is 41".5 and with a power of 45 it should look as large as does the moon to the naked eye.

Saturn is a few degrees to the east of Jupiter, but nearly three magnitudes fainter, and is moving westward among the stars as do all planets when near opposition. It will be in opposition on March 12. The earth passed through the plane of Saturn's rings for a second time within a few months on February 22 and is now on the same side of their plane as the sun We see the bright side of the rings but at a very small angle. W. H Pickering states that his observations of the rings lead him to believe that while the outer rings are extremely thin, as is well known, the crepe ring has a thickness of not far from 2,000 miles.

Uranus moves a degree and a half eastward in Aquarius during the month. Mercury will pass within 4′ of Uranus on the 25th. Neptune is slowly retrograding in Cancer.



At 11 o'clock Mar 8
At 10½ o'clock Mar 16
At 10 o'clock Mar 23

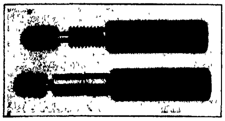
At 9½ o'clock. March 29.

At 9 o'clock. Apl 7.
At 8½ o'clock: Apl 14
At 8 o'clock Apl 22

NIGHT SKY: MARCH AND APRIL

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Fitting the gage with a tiny brush expedites gaging operations

A Pilot Brush for Gages

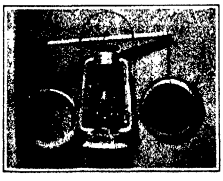
IN the practical use of fixed dimension gages the gage is used to test the accuracy of work. The article tested is frequently taken directly from the machine in which it was finished and the surface to be gaged is apt to be covered with oil, specks of dirt, chips or particles of abrasive material. Of course these foreign substances are detrimental to the gage surfaces, and to overcome such objections a Massachusetts manufacturer has brought out a pilot brush device which is used as a cleaner as well as a pilot. Gages are drilled and tapped to receive the brushes.

A New Use for Pie Tins

DEATH-DEALING baits, violent destruction by use of gun and dog, traps and other ensnarements, and even the building of a coyote-proof fence are among the methods of arresting the encroachments of coyotes in the West, a predatory animal so destructive to domestic livestock. It remains, however for a ranger of the United States Forest Service operating in Utah to employ a simple but clever method of "shooing" away the sneaking thieves of the cattle and sheep ranges.

Acting upon the theory that wild animals are suspicious of artificial illumination, lighted lanterns are stationed near bed grounds used by sheep in timber line ranges of the National forests. These all-night beacons have their light reflecting powers multiplied by suspending a new shining tin plate on each side of the lantern. This arrangement is effected by means of a rod tied to the handle of the lantern, made secure by insertion in the ring of the hood of the lighting fixture the tin plates being suspended by strings from the ends of the rod.

The free swing of the coyote guard lantern plates sends forth periodical flashes of illumination from the lantern which penetrate the darkness, throwing fright into the camp of the marauding pest whose stealthy invasions of sheep herds may be of nightly frequency. Other than reflecting a weird flash of light, a strong wind may serve to create a jangling noise. The ingenious forest official does not tell us how the guard-lantern plates operate in the absence of a wind. It is to be assumed, however, that the range of its effectiveness is somewhat controlled by the power of wind currents to keep in constant motion the light-reflecting plates.



This arrangement of a lamp and pie tins serves to drive away coyotes

Checking Up the Slip Gage

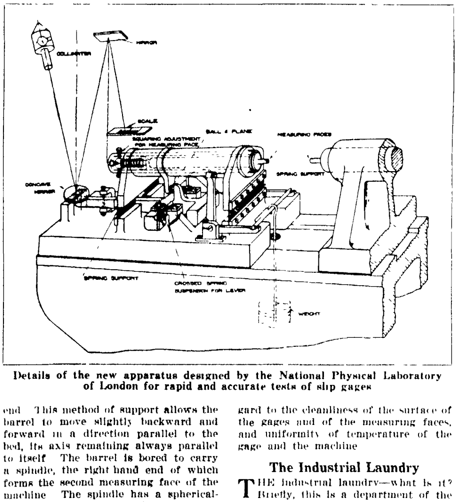
DESIGNED for making rapid and accurate tests on slip gages of the Johansson type, a device has recently been perfected by the National Physical Laboratory of London, England.

The bed of the machine carries two headstocks which are securely held down in position. The right-hand headstock carries a plunger which is lapped to be a good sliding fit in the bore and is held in position by two locking screws. The face of the plunger is flat and square to the axis of the plunger. The base of the left hand headstock is screwed to the bed and supports a barrel by means of flexible steel strips at each end. This method of support allows the barrel to move slightly backward and forward in a direction parallel to the bed, its axis remaining always parallel to itself. The barrel is bored to carry a spindle, the right hand end of which forms the second measuring face of the machine. The spindle has a spherical-shaped collar at the right end which rests on a beveled facing at the end of the barrel, the contact being maintained by a spring placed inside the barrel. The barrel is bored to clear the spindle, the tail end of which is held between the points of two pairs of set screws placed at right angles and screwed into tongues at the rear end of the barrel. By adjustment of these set screws the spindle can be tilted on its spherical seating until the two measuring faces are brought accurately parallel. As the faces were required to be parallel to an order of a millionth of an inch, this adjustment needed to be very sensitive and was provided for by the spring action of the four tongue pieces in which the set screws were mounted.

The pressure between the measuring faces is derived from weights suspended by a rod hanging in a recess in the bed. The force is transmitted to the barrel by two bell crank levers placed one on each side of it. The working pressure of the machine can be readily adjusted to any definite figure by varying the amount of the suspended weights.

To open the measuring faces for inserting a gage the barrel is moved slightly to the left on its flexible supports, by means of a lever. The lever is connected to a spindle carrying an eccentric disk which operates on a stop fixed to the lower part of the barrel. Having inserted a gage, the lever is turned to disengage the eccentric and the left hand measuring face is automatically brought in contact with the gage by the action of the weights.

It is claimed that the machine will repeat its readings to within one tenth of one scale division or one millionth of an inch, but to obtain such repetition extreme care has to be taken with regard to the cleanliness of the surface of the gages and of the measuring faces, and uniformity of temperature of the gage and the machine.



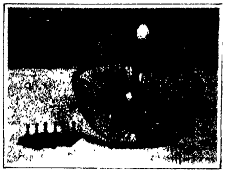
Details of the new apparatus designed by the National Physical Laboratory of London for rapid and accurate tests of slip gages

The Industrial Laundry

THE industrial laundry—what is it? Briefly, this is a department of the large plant which recovers lubricating oil from wipers and waste, and reclaims wiping and waste materials. Most of our leading industries are today conducting industrial laundries because it pays to do so. These industries are obtaining from 15 to 30 times the ordinary service from their wiping and cleaning materials. Many of them wash overalls jumpers, towels and such for their employees, and at a profit. Indeed, this practice, so experts claim, produces wipers and waste at less than 3 cents a pound.

A Safe Haven for the Spoon

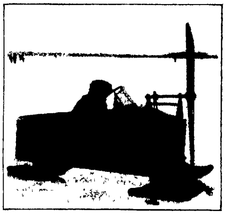
WHAT does the housekeeper in your family do when the spoon with which she is serving dessert slides blithely down into the bowl and gets submerged in the pudding or the peaches? Doubtless she does just what all other housewives have done under these circumstances for generations—fishes it out disappears into the kitchen, and returns with the same spoon washed, or with another one. The same accident occurs often to the individual in connection with his smaller spoon and smaller serving in a smaller bowl—with the same remedy. But a German haus-frau comes with the suggestion illustrated on this page, and designed to keep the spoon on its good behavior. As will be seen at once, the offending tool can slip neither sideways nor straight down, it must stay where it was put, reclining gracefully against the side of the dish, no matter how smooth and slippery the bottom on which its point rests.



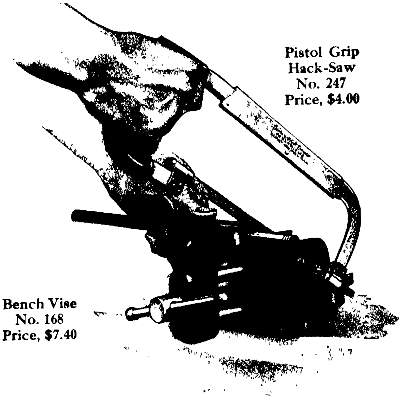
The non-disappearing-spoon holder — an idea from Germany

Still Another Power-Driven Ice Boat

THANKS to the variety of small gasoline motors now available both new and second hand, there has been no end to the power-driven ice boats which have made their appearance during the past few winters. To the large collection of photographs of such craft which has already been published in our columns, we have the accompanying one to add. Here is the ice boat of David Jones of Peabody, Mass., which is said to make a speed of well over a mile a minute on smooth ice and without undue headwind. For a power plant, young Jones has made use of a discarded twin-cylinder motorcycle engine, which drives a tractor-screw propeller through a chain transmission. The front of the body rests on two fixed runners, while the rear is carried by a single pivoted runner which acts as the rudder. There are small supplementary runners fashioned out of steel rod on either side of the front runners, which serve to prevent the ice boat from turning over when rounding curves at high speed.



Ice boat equipped with twin-cylinder motorcycle engine



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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Pertaining to Apparel

WAISTBAND AND THE LIKE.—I. FRIEDMAN, 713 Broadway, New York, N. Y The object of this invention is to provide a strip or band which is folded transversely forming buttonhole receiving portions, the buttonholes being formed through two thicknesses of material comprising the fold and the edges of said fold secured to the body of the strip and providing a finger receiving entrance at the side of the buttonhole

Of General Interest

HAIR CURLER—I MORENILLA, Calle Boliva No 21, Mexico, Mexico This invention aims more particularly to provide a device of this nature which will not alone exercise a clamping action upon the hair, but will further, after such clamping action has been exercised, draw the hair into heated grooves so that a distinctly Marcel wave will result

DUPLEX TUBE—F H. STEGATH, 420 Thompson St, Ann Arbor, Mich The invention relates to tubes for containing liquid, semi liquid or plastic matter An object is to provide a duplex tube which may hold two preparations, so that both preparations may always be found together, and either of the preparations used without any danger of contamination with the other

PILE AND PANEL SYSTEM FOR CONCRETE CONSTRUCTION—C G DABIS, c/o Rock Island Hotel, Little Rock, Ark. An object of the invention is to provide a device which may take the place of caissons or coffer dams A further object is to provide a subaqueous concrete construction which may be readily installed, and which when installed partakes of the nature of a monolithic structure

HONEY-BEE FRAME INSPECTION STAND—R MIFFLER, 449 Marlborough Rd, Yonkers, N Y This invention has reference more particularly to an inspection stand of the class indicated which is adapted to be thrust into the ground at any convenient place, and is adapted to support the honey bee brood frame An object is to provide an inspection stand which will be simple and inexpensive to manufacture

FOUNTAIN BRUSH—W GRACK, Hellaby's Bldg, Auckland, New Zealand The invention relates to a device adapted to be embodied in brushes for various purposes, such as tooth brushes shaving brushes and the like More particularly the invention relates to a brush involving a reservoir or container adapted to receive a replaceable refill cartridge containing paste or other material to be delivered to the bristles through a hollow shank forming a conduit leading to the brush head

PRINTED AND FOLDED SHEET.—S BROWN, 38 Bedford St, Strand, London, W C, England The object of the invention is to provide a printed and folded sheet having at least three leaves or six pages and containing on each page printed matter, and arranged to enable the user to readily turn the leaves from the right to the left to successively bring to view the pages in proper sequence Another object is to enable the user to open the sheet for reading page by page without spreading the sheet far apart

LIGHT METER—C C HOWENSTINE, 19374 Carman Ave, Highland Park, Mich Among the objects of the invention is to provide a meter for determining the strength of light, it is particularly useful in taking photographs, to give the correct exposure for any diaphragm opening and any speed of plate or film; a further advantage is that the meter will operate as well, if not better, in weak interior light, as in strong light The device is not restricted to photographic use, but may be employed in measuring light in buildings, stores, etc

DISCHARGE MEASURING DEVICE FOR LIQUID RECEPTACLES—W P BLAKE, Kirksville, Mo The invention relates generally to liquid receptacles and particularly to a discharge measuring device for bottles, jars and the like, the object being the provision of an arrangement for measuring the discharges, as for instance in the case of dose regulation from medicine bottles.

COMBINED SHOE AND PUTTEE—H. C. DYER, St Luke's Rectory, East Elmhurst, L. I., N Y. The invention relates to an arrangement in which the puttee is of the wrapped type adapted to engage the leg of the wearer in spirally arranged folds. The primary object is to provide a combination shoe and puttee in which the puttee is an integral part thereof, or the puttee may be produced from fabric instead of leather.

SIEVE—E J. OUELLETTE, 406 E. 4th St, Anaconda, Mont. The invention relates to ore concentrators or jigs, and has reference more particularly to a device of this kind comprising a frame, a strut extending across the frame, a screen disposed over the frame, and means connecting the screen and the strut whereby the latter obstructs no part of the screen, the struts being of the upward tapering cross-section form

BOTTLE CASE AND SUPPORT.—C. J. CROSS, 149 Church St New York, N. Y. An object of the invention is to provide a construction of case and support which is primarily designed in connection with bottles containing fire extinguisher, the device being especially adapted for use on automobiles, boats or other moving vehicles, and which will support the device so that it can be quickly used, and will cause the removal of the stopper with the removal of the bottle from its support

PLASTIC COMPOSITION—GUSTAVE EY, 158 5th Ave, Woodside, L I., N Y. An object of the invention is to produce a composition of matter which is inexpensive to make which has correct characteristics to adapt it to the manufacture of dolls, picture frames, statuettes or any model work of articles of commerce, the compound does not stick to molds during the manufacturing process The composition comprises flour, glue, asbestos, cement, whiting, mixed with water

TRUNK APPLIANCE—H. S. CARSON, 5125 Kimbark Ave, Chicago, Ill The object of this invention is to provide a support which may be utilized as an ironing board, a conventional table, or an invalid's table, the device is particularly adapted for use by people who travel, it may be carried in a conventional wardrobe trunk without any additional structure, or might form part of a closet or similar receiving department

BRICK MOLD—R A FONTAINE, c/o Am Truck Body Co, Inc, Martinsville, Va An object of the invention is to provide a mold which will constitute a combined mold and cutter, and which will simultaneously form a large number of bricks A further object is to provide a mold which, when moved vertically, operates to cut the mud in the mold into a large number of standard size brick

BOTTLE CLOSURE—C E BLANCHARD, 3811 Cottage Grove Ave, Chicago, Ill Among the objects of the invention is to provide a bottle closure which does not require to be cemented in the neck of the bottle, but which when inserted in the neck will, owing to its peculiar structure, cling to the neck so that when an attempt is made to remove the closure it will tear

WRITING PAD—G. R CLARK, c/o Armour Co, Center Market, Washington, D C The invention has for its object to provide a writing pad which includes as one of the most important features an endless sheet of paper arranged to be advanced step by step, and capable of being reversed so that both sides of the paper may be filled with writing before it is discarded

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Who Shall Work the Farms?—I

(Continued from page 184)

tality in the total number of farms operated, due directly to the labor shortage.

That one of the most drastic labor shortages which ever confronted American agriculture is today as firmly entrenched as the wolves of want during times of famine is known generally among the farmers. They are doing their best to meet and combat the emergency. By working longer hours in the field, by squeezing the last drop of efficiency out of daylight saving as applied and adapted to practical farm conditions, by the more intensive utilization of family labor, by decreasing the acreage of tilled crops, by renting out as much land as possible to reliable tenants competent to farm the land intelligently and well, by increasing their annual pasturage and green cover crop allotments which may be harvested by live stock and converted into valuable meat and dairy products, by using more and better fertilizers and heavier machinery—especially tractors, these farmers from Maine to Texas and from California to New Jersey have been doing their best to solve that contrary conundrum—the task of performing the work of four men with a force of three

Conditions in Michigan are fairly representative of the dearth of farm workers which is prevalent in a number of the western states Approximately 8.75 per cent of the farms—an aggregate area of about 1,000,000 acres equivalent to the combined acreage of five average counties —were idle in 1920 The total manpower available for working the land which is under cultivation consists of 230,000 male workers—many of whom are boys from 15 years of age and upward This means that each of these men or boys had to handle 82.5 acres of farming land during the current season A report as of May 15, 1920, issued by the Michigan Crop Reporting Service showed that 18,232 farms in the state were idle as compared with 11,881 in 1919 While this abandonment, which in many cases is temporary due to lack of tenant farmers, was least in the best farming sections, it is, without question, a community movement. Some districts show no abandonment In other sections where the tendency to abandon the farm was originally of little consequence it has developed and has reached a point where from one third to one-half of the entire school district had migrated to the city

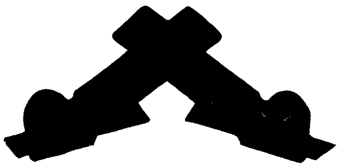
Conservative figures evidence that 60 per cent of the farmers now actively operating farms in Michigan are over 50 years of age The average size of the farms in the state is 91.5 acres and there are only 11 men and boys available for the running and managing of each ten farms Right now there are 30,300 vacant houses on Michigan farms, 10,000 of which have been vacated during the last year Of the 276,000 men employed on farms three years ago, 46,000 have since left the rural districts in order to gain the higher wages offered by the industrial concerns. Twenty thousand farm hands have migrated from the country to the city during the last 12 months Under such conditions is it surprising that Michigan suffered a decrease of 15 per cent in the acreage of cultivation crops planted last season? The fact that the number of dairy cattle in the state declined 11.8 per cent indicates that milk producers are dispersing their herds because they cannot secure and retain the services of qualified and dependable helpers.

The writing on the wall is to the effect that the production of farm crops will decline as long as the present situation—featuring an abundance of work to be done and only a limited force to do it—continues and as long as the costs of producing crops correspond so closely to the market prices which the farmer receives. This simply means that the more the supply decreases, the higher the prices of foods will climb The remedy for this abnormal condition is to curtail the numbers of non-producers of food and to multiply the ranks of the food producers. Such a reversal will result only when the remuneration for growing farm crops is proportionate to the incomes which obtain from other occupations and vocations that now yield attractive returns. It also features the countrywide need of markedly increasing the attractiveness of farm life in order that residence in the country will offer as many inducements to the average laborer as does city life

Prospects are that inflated living costs will continue to a great extent. The labor shortage is vitally acute despite that the average wages paid country help are from 15 to 25 per cent higher than those of last year This is sure to result in decreased production—unless you and I and everybody backs up the farmer, and not with extravagant encouragement and pats on the back but with actual sweat-of-the brow and blistering-of-the-hands assistance. Uncle Sam has been collecting information from every highway and byway over his broad and productive farming territory His summation of potential results in the bread-producing and meat-providing line run about in this wise: "Cultivation this year will be less intensive than formerly More land will be put into grass and such other crops as require a minimum of labor Land which the farmer cannot handle personally, he rents to tenants on the crop share or cash basis In many instances the tenant is furnishing the labor only while the landowner provides everything else The crop is split two thirds to the latter and one-third to the former, or, some instances, on the fifty fifty basis"

Various emergency measures have been suggested for the temporary relief of the farm-help famine Proponents of unrestricted immigration have talked volubly and circumspectly about the benefits from a labor standpoint which would immediately result if the bars which now protect our domestic laborers and keep out the worthy and nondescript of many foreign races which wish to flock to the United States—were let down However to date, all these arguments and discussions have only exerted a smokeless powder, blank-cartridge effect on the farm-labor situation and the chances are far from rosy that anything tangible will ever obtain from such sources

The utilization of convict labor for emergency use on farms possesses more possibilities However this would be largely a matter for state determination Some states may favor the plan while others would be wholly against it Were convict labor to be utilized, the prospects are that short term prisoners—offenders sentenced for terms of less than five years—would be principally used It is this class that has largely composed the road gangs in the states where highway construction has been performed—to a greater or less degree—by convict labor The greatest problem in the handling of convicts would consist in providing them with satisfactory guards and suitable lodgings Tents such as are utilized by the road building forces could be used and the camp could be operated according to army discipline and practice The transportation problem naturally would be of paramount importance and the division of the expenses among the various farmers who utilized such labor would also offer some perplexities In the main, if convicts were used, they would have to be centralized for the most part in rather large units which would limit their services to the larger farms A complete discussion of the convict-labor problem is impossible due to space limitations. It is a matter for state decision and adoption. However as a last resort if ade-



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quate working forces cannot be recruited from other channels, resort to convict labor will have to be made in some sections or else a material percentage of the land will remain uncropped

The army of "floater" labor was of recent years greatly reduced in strength, due to the fact that this has been the era of employment when everyone who wants to work can secure plenty to do at profitable wages Hence the influx into the grain-growing regions of the general run of transient labor which customarily has aided in harvesting has been measurably smaller than in former years The lumber jacks, timber cruisers, fruit pickers and "hoboes" who heretofore have helped out at harvest time have largely transferred their temporary services to the industrial, manufacturing and commercial pursuits where the wages are more attractive and the hours are shorter If the present industrial hesitation should persist throughout the summer of 1921 this situation *would be made normal again*, but no one expects it so to persist, so what we have said for 1920 will probably apply equally to 1921

Farm women—the country over—have always been accustomed to aid as much as possible in the rush of warm weather work Last year they did more than ever before However in the majority of cases they are useful only for the lighter forms of farm labor On dairy farms, the women can help markedly by doing much of the milking thereby permitting the men to put in longer days in the field They also can tend the farm garden, run errands to town, deliver the milk and other dairy products to the railroad station creamery or cheese factory They can attend to the feeding of the live stock and perform the light farm chores They can handle the farm poultry—as they have customarily done for many years They also can accomplish invaluable work in the way of picking and packing fruits and vegetables There are a hundred and one ways in which they can and their men folks so that the latter can devote their undivided attention to the growing and care of the crops But as a general proposition they cannot do the heavy field work that constitutes the backbone of farming

Salvaging Torpedo Boats for Peaceful Uses

(*Continued from page 185*)

and to act as convoys for troop ships For nearly two years the destroyers met the exacting demands of real war service Yet officials assert that the hulls are as rugged and tight as on the day they were put together There has not been found the slightest sign of structural weakness in any of the vessels If the need had arisen they could have gone to sea again Now it is too late, for workmen with oxy acetylene torches and chisels and steel drills have gone into the hulls and torn out the machinery These boats were retired primarily because they are coal burners The space available for coal bunkers was so small that their cruising radius was limited and they could not stay at sea so long as oil burning destroyers It is a fact also that they were outclassed by the newer torpedo boats of the American Navy which turn up thirty five knots an hour But it should not be assumed from this that the old boats are slow Even on the day of their retirement they were said to be good for an average of twenty five knots each The "Bainbridge," probably the fastest of the thirteen, turned up 28 5 knots on her trial trip

The yard that is renovating these craft was established fifty years ago and now disposes of from thirty to fifty ships a year In the yard at present, in addition to the torpedo boats, are the old Ward Liner "Seguranca," twice sunk during the war by German submarines, and the "Malabar," formerly H. M. S. "Terror," a troop and convict ship. This latter vessel is to be turned into an oil tanker. She had been tied up at Bermuda for thirty years, but is still seaworthy. Her towering sides, built to accommodate tier upon tier of decks containing hundreds of berths, are to be cut down and she will be plated over in the whaleback style

The "Seguranca" was once in the transatlantic service and carried thousands of passengers She was taken over for troopship service during the war and was caught by a torpedo the first time near Lisbon, Spain When shipping became scarce as the toll of war grew, she was raised, repaired and put back into service only to be hit for the second time near Bermuda Lying on the bottom in shallow water, she was sold to the junk man and salvaged It has been found that her hull is still sound enough to repair, and it is likely that this boat will go back into passenger and freight service

From the Einstein Contest—III

(*Continued from page 187*)

by a contraction of these same instruments in the direction of their motion This contraction obviously cannot be observed directly because all bodies, including the measuring instruments themselves (which after all are only arbitrary guides), will suffer the contraction equally According to this theory, called the Lorentz-Fitzgerald contraction theory,][27] all bodies in motion suffer such contraction of their length in the direction of their motion, [the contraction being made evident by our inability to observe the absolute motion of the earth, which it is assumed must exist][27] This would suffice to show why the Michelson-Morley experiment gave a negative result, and would preserve the concept of absolute motion with reference to the ether

[Now it will be clear that this explanation is a very *special* one, that is, it applies only to the particular experiment in question And indeed it is only one of many *possible* explanations Einstein conceived the notion that it might be infinitely more valuable to take the most general explanation possible, and then try *to find from this its logical consequences* This "most general explanation" is, of course that it is impossible in any way whatever to measure the absolute motion of a body in space][27] Accordingly Einstein *enunciated, first the* Special Theory of Relativity, and later the General Theory of Relativity The special theory was so called because it was limited to uniform rectilinear and non rotary motions The general theory, on the other hand, dealt not only with uniform rectilinear motions but with any arbitrary motion whatever

The hypothesis of relativity asserts that there can be no such concept as absolute position, absolute motion, absolute time, that space and time are interdependent, not independent, that everything is *relative to something else* It thus accords with the philosophical notion of the relativity of all knowledge [Knowledge is based, ultimately, upon measurement, and clearly all measurement is relative, consisting merely in the application of a standard to the magnitude measured All metric numbers are relative, dividing the unit multiplies the metric number Moreover, if measure and measured change proportionately, the measuring number is unchanged Should space with all its contents swell in fixed ratio throughout, no measurement could detect this, nor even should it *pulse* uniformly throughout Furthermore, were space and space-contents in any way systematically *transformed* (as by reflection in curved mirrors) point for point, continuously, without rending, no measurement could reveal this distortion; experience would proceed undisturbed][28]

[Mark Twain said that the street in Damascus "which is called straight," is so called because while it is not as straight

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as a rainbow it is straighter than a corkscrew This expresses the basic idea of relativity—the idea of *comparison* All our knowledge is *relative*, not *absolute*, Things are big or little, long or short, light or heavy, fast or slow, only by comparison An atom may be as large, compared to an electron, as is a cathedral compared to a fly The relativity theory of Einstein emphasizes two cases of relative knowledge, our knowledge of *time and space*, and our knowledge of *motion*]"⁴ [And in each case, instead of allowing the notions of relativity to guide us only so far as it pleases us to follow them there abandoning them for ideas more in accord with what we find it easy to take for granted, Einstein builds his structure on the thesis that relativity must be admitted, must be followed out to the bitter end, in spite of anything that it may do to our preconceived notions If relativity is to be admitted at all, it must be admitted *in toto*, no matter what else it contradicts, we have no appeal from its conclusions so long as it refrains from contradicting itself]*

The hypothesis of relativity was developed by Einstein through *a priori* methods, not the more usual *a posteriori* ones That is, certain principles were enunciated as probably true, the consequences of these were developed, and these deductions tested by comparison of the predicted and the observed phenomena It was in no sense attained by the more usual procedure of observing groups of phenomena and formulating a law or formula which would embrace them and correctly describe the routine or sequence of phenomena

The first principle thus enunciated is that it is impossible to measure or detect absolute translatory motion through space, under any circumstances or by any means The second is that the velocity of light in free space appears the same to all observers regardless of the relative motion of the source of light and the observer This velocity is not affected by motion of the source toward or away from the observer, [If we may for the moment use this expression with its implication of absolute motion]* But universal relativity insists that motion of the source toward the observer is identical with motion of the observer toward the source

[It will be seen that we are at once on the horns of a dilemma Either we must give up relativity before we get fairly started on it, or we must overturn the foundations of common sense by admitting that time and space are so constituted that when we go to meet an advancing light impulse, or when we retreat from it, it still reaches us with the same velocity as though we stood still waiting for it We shall find when we are through with our investigation that common sense is at fault, that our fixed impression of the absurdity of the state of affairs just outlined springs from a confusion between relativism and absolutism which has heretofore dominated our thought and gone unquestioned]*

[But it is obvious from what has just been said that if we are to adopt Einstein's theory, we must make very radical changes in some of our fundamental notions, changes that seem in violent conflict with common sense It is unfortunate that many popularizers of relativity have been more concerned to astonish their readers with incredible paradoxes than to give an account such as would appeal to sound judgment Many of these paradoxes do not belong essentially to the theory at all There is nothing in the latter that an enlarged and enlightened common sense would not readily endorse. But common sense must be educated up to the necessary level

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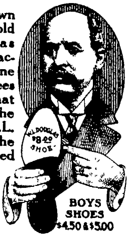

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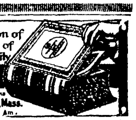

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trouble consisted in taking up-and-down as an invariable direction, a habit firmly implanted by long familiarity with a flat earth. Something similar afflicts us today. In all ordinary terrestrial matters we take the earth as a fixed body, light as instantaneous This is perfectly proper, for such matters But we carry our earth-acquired habits with us into the celestial regions Though we have no longer the earth to stand on, yet we assume, as on the earth, that all measurements and movements must be referred to some fixed body, and are only then valid. We cling to our earth-bound notion that there *is* an absolute up-and-down, back-and forth, right-and-left, in space. We may admit *that we can never find it*, but we still *think it is there*, and seek to approach it as nearly as possible And similarly from our earth experiences, which are sufficiently in a single place to make possible this simplifying assumption, we get the idea that there is *one* universal time, applicable at once to the entire universe." [The difficulty in accepting Einstein is entirely the difficulty in getting away from these earth-bound habits of thought.]*

Making Weather to Order

(Continued from page 188)

ready for the oven and his success as a baker depended on his ability as a guesser There were two reasons for his troubles the varying humidity and the bacteria of the air both affected the raising dough Conditioning the air not only makes it and keeps it just right for the yeast to work best, but it washes from the air all dirt and bacteria Scientific tests have proven this latter statement The modern baker makes his bread according to formula and instead of guessing when his bread is ready, looks at his watch and knows Manufactured weather has been successfully applied in a number of industries where fermentation is a part of the process

The air engineer has also made it possible to introduce quantity production methods into the woodworking industries, where, heretofore, each piece had to be cut and fitted individually A piece made to fit today, a week hence would probably be either too big or too small as it had shrunk or swollen from atmospheric conditions By keeping the air constantly at the same humidity the same quantity-production methods used in the metal industries are possible in wood-working This fact was proved conclusively in the huge U S Naval Aircraft Factory at League Island, Philadelphia The complete operation of building naval aircraft was carried out here in conditioned air and not only were manufacturing problems simplified, but the finished aircraft leaving the factory with a uniform moisture content in its parts, contracted and expanded equally under outside weather conditions, resulting in a more reliable craft

For years it has been considered almost impossible to manufacture fine chocolates in summer Chocolates exposed to the heat and humidity of an ordinary summer day lose their rich dark brown color and silken "finish" and assume a pale tan shade If the same chocolate were cooled and "set" as soon as it was dipped, it would retain its appearance and flavor, and if properly packed and kept would reach the consumer in perfect condition Upon the old time assumption that the difference between summer and winter was merely a matter of temperature, it has been the practise of candy makers to install refrigerating coils in rooms where the chocolates were dipped. The air immediately surrounding the coils became too dry through condensation on them and the rest was too wet. Besides the coils were unsanitary, dangerous if a leak developed and they were not subject to automatic control. The automatic weather man has saved the day here, too, and in many modern candy factories the right brand of weather is made before it enters the factory and it is always right.

Three of the largest chewing gum factories now are equipped with air conditioning apparatus Air at the right temperature and humidity and free from impurities contributes largely to a uniformly good product

Manufactured weather has solved a rather knotty problem for the rubber manufacturer The first process in treating the raw rubber is to wash it. It is reduced to sheets which must be dried before they can be further processed. The drying is done in a temperature warmer than ever the tropics produce but the rubber cannot be exposed to these high temperatures without injury unless the humidity is relatively high. Other systems are quicker but they injure the rubber, whereas if the proper atmosphere is supplied the rubber dries in a very few hours and it is actually improved in quality.

Mechanical weather is used in nearly every branch of the laboratory work of the motion picture industry from the drying of the celluloid film base to the drying of the finished films Humidity has an interesting effect on film If the air is too damp the film becomes opaque and if too dry, the film becomes brittle and cracks The limit between the two conditions is very narrow and the use of conditioned air saves thousands of dollars' worth of valuable film

The drying of macaroni and noodles presented particularly difficult technical problems which have been solved by air conditioning

In one of the large tobacco factories where machines are used for stripping the stems from the tobacco leaves, the room in which this operation took place was so filled with injurious dust that one could hardly see its length. Of course the labor problem there was a very difficult one. When the weather engineer was called in, instead of trying to remove the dust he supplied enough humidity to keep the tobacco leaves from getting brittle and prevented the formation of the dust Now air conditioning has been introduced into all branches of the tobacco industry in which weather has always been a large factor, with a resultant saving of thousands of dollars each year

Before the mechanical weather man invaded his field the manufacture of electrical insulators and other ceramic materials used to stand a loss of between 20 and 35 per cent in his "green" pieces spoiled in the drying This loss has been reduced to between 2 and 5 per cent.

Certain chemical processes in which temperature and humidity are factors, notably the making of ammonium nitrate for explosives, have not only been speeded but made practicable on a large scale by air conditioning Other interesting applications to which many pages could be devoted are in preventing static electricity in printing newspapers and magazines, in the manufacture of paper, in the making of medical capsules, etc

But undoubtedly the largest application is yet to be made; that is for non-industrial purposes—in the homes, schools, churches, theaters, office buildings, etc Mr Willis H Carrier, to whose foresight and engineering skill the art owes much of its present status, is a firm apostle of the thought that good weather in the home is just as essential as in the industries.

"You'd laugh at a house without a heating system," says Mr. Carrier, "and yet such a house would be no more absurd than a house without a cooling system. Why should we regard summer as a time when we must simply grin and suffer from the heat, any more than we should regard winter as a time when we must smile cheerfully and suffer from the cold?

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weather in the winter, because such equipment not only heats efficiently, but humidifies Some day we'll look back on our present steam radiators, hot air furnaces, and other 'dry' heating systems, with the same sort of feeling with which we now regard the old-fashioned pot-bellied stove of grandfather's day, which used to toast his face while shivers ran up and down his spine"

Air Plus Oil Equals More Oil

(*Continued from page 190*)

the deep seated oil sand under pressures ranging from 40 to 300 pounds These are termed "air wells" to distinguish them from the other wells from which the resultant oil is pumped in the usual fashion The apparatus required is comparatively simple In the main it consists of an air compression driven by a gas engine which may be from 20 to 100 horsepower the choice being determined by the quantity of air to be delivered underground and by the pressure needful to stimulate the movement of the oil The air is piped from the compressor to the wells chosen, and there the line is connected with the metal casing or tubing which extends to the bottom of the drill hole and into the oil sand At a suitable point down in the hole an air-tight collar of cement is formed to prevent the air from rising surfaceward through the unfilled drill-hole With everything ready the compressor is started, and, if the proper precautions have been taken, the pressure of the air accumulating underground will fill the space previously occupied by the natural gas

The engineering problem is to see to it that the air gets into all parts of the sand where there is petroleum and to prevent the air from being lost or wasted by reaching into areas where there is little if any soil As might be expected, the air tends to follow the easiest and shortest route between its points of discharge from the air wells and the avenues leading upward by way of the pumping wells It is practicable so to regulate the flow of the oil surfaceward in the pumping wells as to set up back pressures—much like the condition induced by holding in restraint natural gas when present This procedure enables the operator to build up the subterranean pressure and thus to effect the distribution of the air throughout the oil sand

Sometimes so-called "tight" sands are intermingled with those of an open character, and if the air pressure were not distributed, as in the manner just described then the expulsive medium would short circuit around these less yielding beds and fail to drive out of them the oil with which they may be laden On the other hand, if the oil sands are principally of a compact nature, the petroleum could not be recovered in paying quantities unless means were taken to maintain a satisfactory back pressure for the purpose of inducing a complete penetration of the air Petroleum in a tight sand migrates slowly, and this movement is further influenced by the density of the oil and the percentage of its paraffin content

The favorable outcome, when compressed air is used, depends to a considerable extent upon the choice of the wells through which the air is to be forced downward It is essential that these wells be so placed or circumstanced as to reduce to a minimum the likelihood of the air being wasted by running off into neighboring formations that would facilitate its dissipation Having decided that it is worth while to try compressed air upon a given area with which the operator is conversant geologically his next step is to determine the size of the compressor plant commensurate with the local requirements In the Appalachian oil fields this is done by using a handy five-horsepower portable testing compressor In this way, it is possible to learn how

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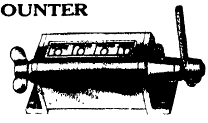

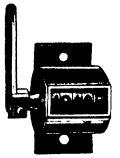

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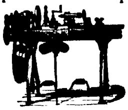

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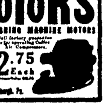

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much air the sand will take and also to discover what pressure is needful to induce initial absorption of the air, for it is a fact that the sands are all of them more or less resistant. Finally, having found out the maximum pressure at which the sand will drink in all of the air that the testing plant can deliver, it is a comparatively easy matter to fix upon the proper installation

Taking the results generally, an average of 10,000 cubic feet of free air is pumped into each well daily That is to say, if there is one air well and three oil wells, 40,000 cubic feet of air must be forced under ground every twenty four hours. The measure of power for this service is determined directly by the perpendicular thickness of the sand The time elapsing before an increase in oil production is noted may vary all the way from less than a week to a period of months, and for this reason an operator should not be discouraged if he reaps no immediate gains The underground conditions and the extent of the area he is seeking to influence will have their several effects upon the outcome Even so, as already pointed out, the results in a large percentage of the installations richly compensate for the expense involved

The layman must not imagine that the favorable displacement or movement of the petroleum is accomplished after the fashion of the urge of a solid body of water carrying and lifting the mass of oil The compressed air mingles with the petroleum, creates an oleaginous froth, and this progressively breaks its way through the sand toward the intakes of the pumping wells This commingling of the air with the oil does not, contrary to the fears of some operators, hurt the ultimate commodity in any way There is no doubt, however, that the air will dilute the natural gas where this is present, and this dilution may diminish the value of the gas as a source of energy for gas engines or as a medium for heating purposes Even so, the impairment of the natural gas as a fuel is offset by the returns from the increased output of petroleum

As an alternative in stimulating the yield of oil, the practice has been encouraged of flooding the wells in some of our oil fields—relying upon the rising tide of the water to lift or to drive the petroleum toward the pockets or shot holes at the bottom of the wells This procedure has undeniably augmented the flow of oil by a few barrels daily, but it also tends to waterlog the oil sand more or less completely and may damage neighboring properties On the contrary, compressed air does not bring about the same serious or permanent underground changes and, broadly stated, it would seem that the compressed air method costs less and gives richer results as a rule than flooding In conclusion, there is warrant for the belief that the compressed-air process may yet enable us to add to our domestic oil supply anywhere from six to twelve billion barrels of petroleum that otherwise would remain underground.

The Papaya, or Tree Melon

(*Continued from page 191*)

est by fire or otherwise, the papaya often springs up from seeds dropped by birds. Small groups are commonly found growing about huts, where they seem to thrive without any cultivation whatever In Hawaii, almost any well-drained soil seems to be suitable, but, ordinarily. rich loam or humus on a hillside is the soil that the papaya likes best

Since the plant is filled with moisture, it flourishes in regions where there are heavy rains every day and high temperatures both day and night. In California, the nights are too cool for it. In favorable soils and climates, it grows rapidly and with great luxuriance, sometimes fruiting in seven months from seed and bearing in a single season from twelve to sixty fruits weighing five to twenty pounds apiece. This enormous yield is almost continuous for about three years, after which the tree steadily deteriorates.

It is to be hoped that, with improved conditions of cultivation, the papaya will soon become much more common in our markets, as it deserves to be because of its agreeable flavor, its importance as a food, and its value in combating that American disease, dyspepsia.

Most of the accompanying illustrations are made from photographs taken by Mr. Nelson Popenoe at the Plant Introduction Field Station, Miami, Fla.

The Trumpeter Swan

(*Continued from page 191*)

ber ranging from 1,312 in 1854 to 122 in 1877. It is now put down by naturalists as very rare, anywhere within its former range. While the breeding range was limited to the interior of Canada, in winter, it was distributed south from the limit of open water through the western United States to Texas and South Carolina On the Pacific it was common from central British Columbia to southern California In 1915 Coale, the American naturalist, notes that "of the great number of trumpeter swans which traversed central and western North America sixty years ago, there are only 16 specimens preserved in museums which have authentic data"

The British Columbia colony was first located upon about a year ago by a local ornithologist As soon as it came to the knowledge of the Dominion Parks Commissioner a guardian was put over the birds The exact location of the colony has not been divulged The lake where they were found is open all the year around and it is stated that the swans do not go south, nor indeed, do they leave Canada at all. They go north in summer, but their range of migration is extremely limited Efforts are now being made to locate exactly their summer habitat

As many as one hundred have been counted in the colony, and the Dominion Parks Branch has succeeded in securing motion pictures of 19 of them. The problem now before the Government is whether these remaining members of an almost extinct but extremely interesting species of North American water-fowl can be preserved A determined effort in this direction is being made and it is hoped that it may be as successful as the handling of the buffalo, which are now becoming so numerous on the Canadian range at Wainwright as to be embarrassing

The description given of the swans shows conclusively that they are genuine trumpeters They are pure white in color and very large. Although they have not been handled, those who have observed and photographed them put the extreme length of the largest of them at between 5 3/4 and 6 feet, and their height, standing, at between 3½ and 4 feet, while their weight is estimated at around 30 pounds. The sonorous voice, resembling the notes of the French horn, which has given them their name, is understood to have first led to the discovery of the present colony.

The naturalist's notes on them are interesting. They are stated to be distinguished from the whistling swan by their larger size, and other particulars. Their bills are entirely black, longer and narrower than those of the whistling swan, with the nostrils placed farther back, and, of course, there is a pronounced difference in the note of the fowl The nests of the British Columbia birds are large and built of hay, rushes, and feathers, carefully lined with feathers and down. The eggs are elliptical in shape, from two to six in a nest, and measures from 4 to 4½ inches by from 2½ to 2¾, being pure white in color with a rough surface. Their food consists of leaves and seeds besides water plants and insects.

IN THIS ISSUE:

BRIEF FACTS ABOUT MONEY
SOLVING THE LABOR PROBLEM

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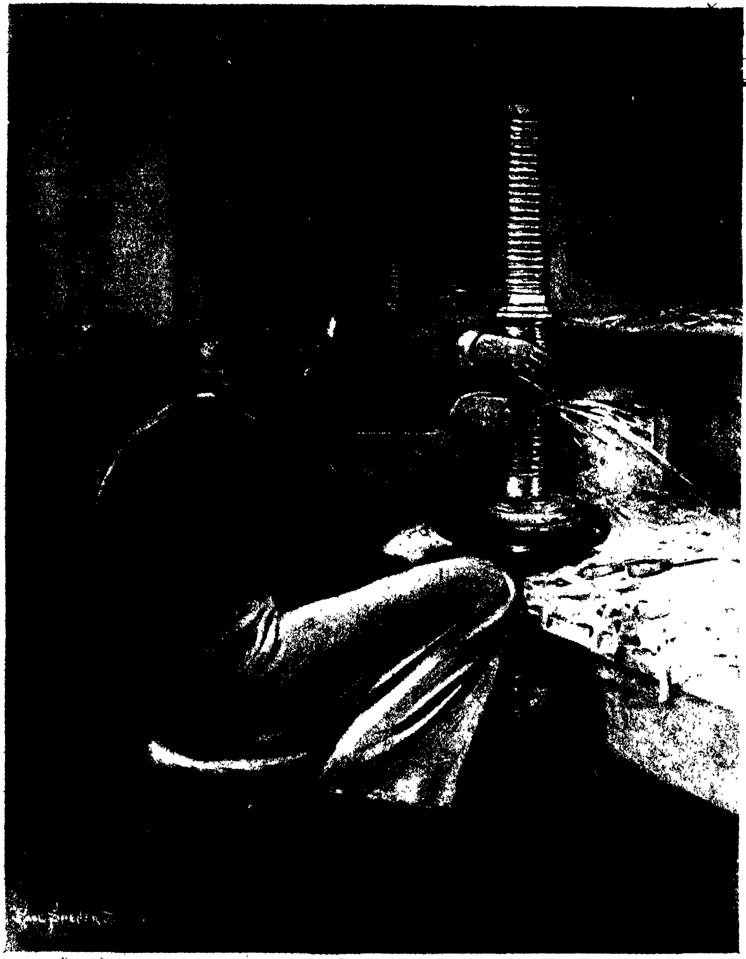

SPINNING AND CUTTING A MASS OF SOFT CLAY TO FORM AN ELECTRIC INSULATOR.—[See page 205]

Vol. CXXIV. No. 11
March 12, 1921

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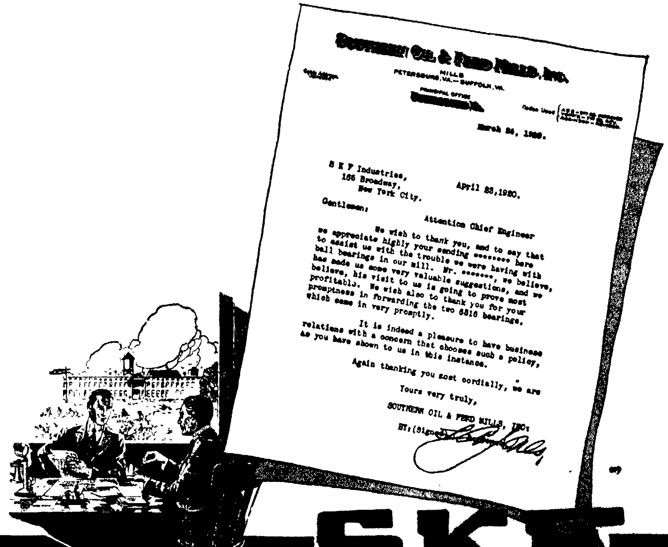

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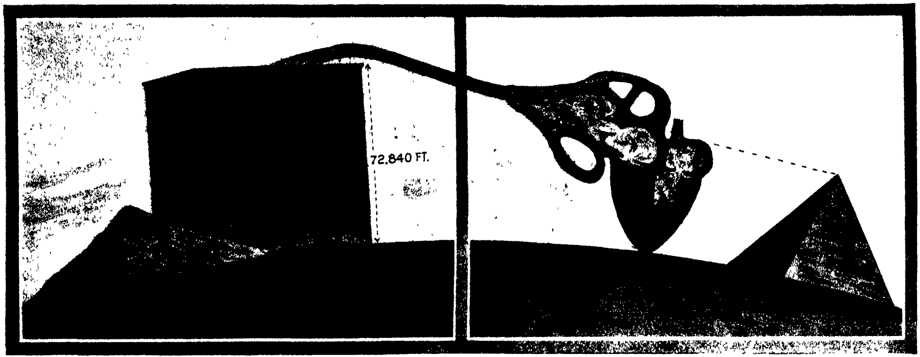

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The composite bulk of all the human hearts in the world, and the labor of pumping that they perform

The Heart as a Pumping Engine

By Charles Nevers Holmes

WHAT a wonderful pumping engine is the human heart! From our cradle to our grave, its work is incessant—stupendous Within each human breast, this energetic organ is beating, on an average, about 75 times per minute, or 4,500 times per hour Accordingly, the heart beats, approximately, 108,000 times daily, 39,000,000 times yearly, and during a lifetime of three-score and ten years, two billion seven hundred million times. If we estimate the population of our world at 1,700,000,000 people, then all the human hearts on our terrestrial planet are beating at the rate of, approximately, 127,000,000,000 times per minute or 66 quadrillion times per year That is to say, these 1,700,000,000 human hearts are throbbing at a rate of about 2 billion times per second

As we well know, our heart-engine contains four compartments, two auricles and two ventricles The auricles are reservoirs, which supply the pumping ventricles with blood Therefore, the dynamic energy of the human heart resides in the right and the left ventricles When these ventricles contract, the right ventricle sends its supply of impure blood to be purified by the oxygen in the lungs, and the left ventricle forces its supply of purified blood to circulate in the body When the "heart beats," that is, when the right and left ventricles beat, an average of about 10 cubic inches of blood is expelled from the heart engine. Accordingly, in a minute, after 75 heart beats the energetic heart has pumped 750 cubic inches of blood. That means the heart pumps 45,000 cubic inches of blood per hour, 1,000,000 cubic inches of blood per day, and 392,000,000 cubic inches or more than 225,000 cubic feet of blood per year. Were the heart a water pump instead of a blood pump, it would expel, inasmuch as a cubic foot of water weighs about 62½ pounds, approximately, 7,000 tons of water, during the course of one year

And this amount of work is accomplished by only a part of a small muscular organ about as big as the average human fist! It has been estimated that the left ventrical alone exercises sufficient pressure per square inch to support a column of blood 9 feet in height, and that it performs daily an amount of work equal to 90 foot-tons Were we able to collect in a cubical reservoir all the blood pumped by one heart engine in one year, that reservoir would be about 61 feet in each of its three dimensions Or, were it a circular water-tower, with a diameter of 50 feet, it would be somewhat more than 115 feet in height, and it would contain about 1,700,000 gallons Our drawing depicts the size of a heart representing the combined bulk of all the hearts in the world, and the work performed by the combined hearts in the course of a year

A Small Submarine Designed for Scientific Research

THE submarine, rightly regarded during the war as the most dreadful monster of the deep, is at last to be tamed and made to serve man instead of destroying him At a recent meeting of the French Academy of Sciences, in Paris, M Maxine Laubeux discussed the possibilities of such a baby submarine He is of the opinion that by its means the various strata of the ocean could be explored directly instead of indirectly, as is now necessary, to a depth of from 80 to 100 meters. According to the figures carefully worked out by him as being most suitable for such a submarine vessel, the length should be 18.80 m., the diameter 2.30 m., and the displacement about 50 tons The hull is revolving, all the sections being circular. The body is so constructed as to resist safely the pressure corresponding to a depth of from 80 to 100 meters of salt water Special precautions are taken to keep all openings absolutely water tight even in case of accident In order to enable it to sit flat upon the bottom of the ocean, the submarine is provided with two keels, while to prevent it from having trouble with currents in tidal waters it is propelled by batteries and an electric motor. The batteries are 43 in number each weighing 188 kg The motor has an effective power of 50 hp. at 420 r.p.m., with a current of 80 volts

Under these conditions the maximum velocity of the boat should be about 6 knots on the surface and 4.75 knots when submerged.

Its radius of action at half speed is as follows Sixty miles on the surface at a speed of 3 knots and 50 miles when submerged at a slow speed of 2.50 knots per hour

The submarine is to contain the following apparatus besides that required for its own operation A 30-ton centrifugal pump operated by the principal motor, a 3,000-liter piston pump capable of exerting a pressure of 10 kg with the electric motor, a periscope, two windlasses—one for the grappling iron and one for the rear weight, two reservoirs of compressed air (from 150 liters to 120 kg.) an electric fan for use during the recharging of the battery, a compass, a telephone, a grappling iron of 80 kg weight and 160 meters of steel cable, an 80 kg lead weight for plumbing with 160 meters of steel wire cable

The estimated price of such a scientifically equipped submarine is 600,000 francs or possibly more whereas when the project was first considered in 1907, it was estimated that the cost would be less than 200,000 francs

It is between the surface and a depth of from 80 to 100 meters that most of the great schools of fish which serve mankind as food move and have their being, and it is for this reason that the information gained by such a boat is expected to be so important Its various functions would include taking samples of the surface layer of the bottom of the ocean at different depths, taking samples of the water in various locations and at different depths in order to make a study of the density, temperature, percentage of salt, etc., and obtaining samples of the plankton upon which so many fish depend for food Obviously the distribution of plankton and the circumstances favorable to its growth are all-important with regard to the abundance of the fish which feed upon it Other valuable information would also be gained by studying the degree of transparence of the water and the intensity of the light at different depths Finally, the direction and velocity of the currents at various depths would be especially investigated and would undoubtedly prove valuable in various ways not only to the meteorologist but to the captains of ships and to fishermen

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"A Strong Navy"

WE are in receipt of a letter from an ex-officer of the United States Naval Reserve force who is puzzled by the present attitude of the SCIENTIFIC AMERICAN toward the United States Navy "I noted with gratification in the old days,' he writes, "that you were ever the champion of a strong navy What has happened? Has the controlling ownership changed? Are you the same journal which ten years ago cried out for a strong navy?

Possibly the same question has arisen in the minds of other readers, so we take this opportunity to state that nothing has happened, that the controlling ownership has not changed, and that we are the same journal which ten years ago—twenty five years ago for that matter- and down through the years without a break, has been consistently the friend of the Navy and has done its best to encourage Congress and the people to build up a strong navy

It is not we who have changed, but the General Board of the Navy and the Senate Naval Committee, who, since the armistice have adopted an entirely new policy, for at the close of the war they demanded the strongest navy in the world and today they ask for a navy as strong as any other

To understand the significance of this we must remember that the pre-war policy of the General Board was to carry on a continuous program of construction, which would give us by 1921-1922 a total of 48 battleships including our earlier ships This policy would have put our navy in the second place, which we had held in 1904, but, due to Congressional neglect, had since lost to Germany By the wiping out of the German fleet we moved up to the second position The General Board then raised its standard by demanding that we build a navy stronger than any other

The British have insisted that because of their insular security they should possess a navy stronger than that of any other Recently they have stated semi-officially that they would view without alarm the construction by this country of a navy of whatever strength it saw fit, since the policies of the two countries are so similar that a resort to armed force in place of arbitration of any disputed question was inconceivable If the people of the United States are prepared to bear the expense, the SCIENTIFIC AMERICAN can see no reason why we should not possess a navy equal to any other This, of course, involves the construction of a strong navy and, as we have shown in a recent issue, the completion of the 1916 program (less the six battleships of 43,000 tons), and the addition of some vessels of the smaller types in which we are lacking, will make our navy equal in strength to any other

If for the present we hold up construction on these six ships, it will mean a saving of some 240 million dollars If we go ahead and build them now it will mean that we are greatly exceeding the standard of equal strength above referred to The General Board has suggested that we do not build certain destroyers and other smaller vessels, already authorized, which would have cost about 60 million dollars, and that we utilize 50 millions of that money in the construction of two airplane carriers This is a good suggestion The balance of the 60 millions, together with some 40 millions of the 240 million dollars saved on the six battleships, could be utilized in the construction of flotilla leaders and a few additional scouts Such a program would mean a net saving of at least 200 million dollars and its completion would, in our judgment, give us a fleet which, because it was so thoroughly up-to-date and included all the lessons of the late war, would be more than a match for anything afloat upon the seas by 1923-1924

Let it be remembered also that age is a great determining factor in estimating the relative efficiency of fleets If Great Britain persists in her determination to lay down no new construction it will mean that by the time our new navy is completed her finest battleships will be from eight to nine years old, whereas our latest ships will be only from one to five years old The British ships will mount as their heaviest piece a 15-inch gun of about 84,000 foot-tons muzzle energy, whereas our best ships will mount among them 16-inch guns of 99,000 or 112,000 foot-tons energy, according as they are 45 or 50 calibers in length The British battleships will be of 28 000 tons as against our 32,000 tons, and the armor and torpedo defense of our ships will be far more extensive and heavy Lastly, it must be remembered, reverting again to the question of age, that a battleship ten years old is considered to be obsolescent and ready to pass into the second line

We have made it clear, we trust, that the SCIENTIFIC AMERICAN, in spite of its opposition to the *immediate building of these six ships, is, today as always, an* earnest advocate of our possessing "a strong navy" We think we have made it clear also, that if Congress *decides to spend 240 million on these unnecessary ships,* it will be going far beyond the standard of strength which the Navy Department has itself laid down

Einstein's Finite Universe

THE daily papers have once more featured Dr Einstein on their front pages, this time on the basis of an interview in which he expressed his conclusions with regard to the figure and extent of the universe To those who are at all familiar with the General Theory of Relativity, the fact is not new that it leads to the conclusion that the universe may be finite though unbounded To those lacking this familiarity the statement may be more or less surprising, and to the average layman, not alone do the two terms 'finite" and boundless' carry a distinct contradiction, but the whole discussion comes altogether as a mental upheaval

As a matter of fact, to the qualified geometer and even to the philosopher who is not inclined to geometrize it is anything but that From the earliest age it has been recognized that the universe presents to the human mind a dilemma which in either event transcends our ability to form a concrete picture It is obvious that we must regard the universe as extending infinitely, forever, in every direction, or that we must regard it as not so extending Both possibilities go beyond us The mathematician will make a more or less whole hearted claim that an infinite universe does not go beyond him, but all he means is that he can abstract some of the properties of such a universe and represent them symbolically He can never really picture infinity And certainly, on the other side, the suggestion that the universe comes to an end brings an unanswerable puzzle in the immediate query what lies beyond?

Modern philosophy has suggested a way out of the dilemma For a century or more the notion of a geometrical continuum which shall have no limits and which yet shall not be of infinite extent has been mentally chewed over by philosophically inclined mathematicians and mathematically inclined philosophers The spherical surface is an example of such a continuum in two dimensions It returns upon itself completely, and *so long as we confine ourselves to the two dimensions in which it is defined,* there is nothing beyond it It is finite, yet unbounded, there is no jumping off place To be sure, there is a three-dimensional universe about it, outside it, in which it is immersed, and through which it curves about to meet itself, but that is beside the point

Those skilled in the juggling of the mathematical symbols of hyper-dimensionality have for many years recognized the possibility that the three-dimensional world of our concepts and perceptions may behave in somewhat the same fashion, and be in fact without end and at the same time without limitless expanse. But the suggestion has heretofore been purely one of abstract geometric speculation. No measurements have ever been made which gave the slightest groundwork of observed fact on which to base the belief that the universe was non-Euclidean—which of course it must be if it be finite and boundless. Even Einstein has not been able to make such measurements; but he has suggested a comparatively simple observation which we may confidently hope some day to make, and which would indicate whether the universe is truly infinite or not This business of observing the distribution of matter throughout the universe, ambitious as it sounds, is really a more hopeful thing than the attempted measurement of geodesics in the expectation that they may reveal non-Euclidean characteristics.

It is doubtful whether any of the eminent geometers who have speculated as to the possibility of a finite universe, or even believed in it, would have dared set the size at any such figure as Einstein suggests Ten trillion times the astronomical unit defined by the distance from sun to earth is by all means a tremendous figure, and it does not lose much of its awe-inspiring character when we reduce it to light-years and find that, subject to the large margin of error necessarily inherent in such calculations as these, it would take light a billion years to return to its starting point after "circumnavigating' the universe As one of the newspaper headlines suggests, this is sufficiently near to an infinite universe for all practical purposes.

The Distribution of the World's Four Greatest Liners

IF we except the "Leviathan," it can now be stated definitely what is to become of the four greatest liners, all 900 feet in length or over, about which, ever since the armistice, there has been more or less ambiguity So frequently has it been stated that ships of this size are not revenue earners, that it would not have very greatly startled the public to learn that these ships were to be laid up, and that future passenger service would be carried in those always popular freight-and-passenger vessels which, although their speed is not nearly so great, possess every comfort and convenience that can be found in the 23-knot ship of 50,000 tons and over

The first 900-foot ship to be built was the "Imperator," which was constructed by the Vulcan Works at Hamburg for the transatlantic service of the Hamburg-American Company This fine vessel was not a complete success, being considerably over-weight and overdraft at the time of her launching She is turbine-driven and has made between 22 and 23 knots when in her best condition After the armistice she was allocated to the British Government as part compensation for submarine losses, and she has recently been purchased by the Cunard Line for their New York-Southampton service If she were changed from coal to oil burning and certain unnecessary deadweight were removed from the ship, she should have no difficulty in making her contract speed, if the company so desired

The Hamburg-American Company also laid down two ships of the "Imperator" type but somewhat larger and faster They were built by Blohm and Voss at Hamburg, and the first of them to go into service was the 'Vaterland," which made two or three trips to New York in 1914, and was interned here during the war She is a 23-knot boat and is some 40 to 50 feet longer and two feet wider than the "Imperator" After serving as a transport for American troops she was turned over to the United States Shipping Board, and now for over a year has lain at her Hoboken dock with a caretaking crew aboard. The future of this ship is problematical

The sister ship to the "Leviathan," the "Bismarck," was partially constructed at the outbreak of the war, and work was done upon her during the war in a desultory way She is now completed all but some of her interior furnishings, and she has recently been purchased by the White Star Line, who have renamed her the "Majestic" She also will be placed in the New York-Southampton service.

The fourth in size but fastest of the 900-foot liners is the "Aquitania," of the Cunard Line She is a 900-foot ship, but is somewhat smaller in displacement than the "Imperator" She entered the New York-Liverpool service of the company shortly before the outbreak of the war, and was taken over by the government for transport service. Recently she has undergone overhauling and reconstruction, and under her new oil-burning system this fine vessel has shown that she can exceed her contract speed.

Electricity

Argentine Radio.—From Buenos Aires comes the report that the German Telefunken organization is to construct a high power wireless station in Argentine Republic for the Transradio Compañia Radiotelegrafica Argentina. This company has been organized to operate over-sea wireless telegraphy between Argentina and Europe. Material for the six 210 meter towers, as also the high-tension machinery, was to be shipped shortly; the wireless apparatus itself is not expected until after the erection of the towers

Germany's Experience with Iron Conductors does not seem to have been a happy one. Wires were used for conductors up to 6 mm in diameter, and cables for conductors of larger size. One source of trouble was the inevitable kinking of the line. The galvanizing was easily damaged, and in making joints and erecting the lines extreme care was found necessary. Moreover, iron proved to be 20 per cent more expensive than copper, though the price per kilogram was only 0 71 mark as against 4 marks for copper The use of copper is being resumed as quickly as possible

Electric Hardening of Tools has come into extensive use in Germany, and seems to be quite practical In the process of electrolysis the hydrogen generated at the cathode is heated to such an extent that the cathode itself is brought to a red heat Advantage is taken of this phenomenon by using tools that are to be hardened as the cathode It is, however, necessary to protect the cutting edges of the tools, as they are liable to be raised to excessive temperatures The cutting edges are covered with a layer of non-fusible conducting material

The Nauen Radio Station represents quite nicely the rapid development of wireless Thus it was first installed in 1906 as a modest 10 kilowatt experimental plant, later it was increased to 35 kilowatts, then to 100 kilowatts, and now to two high-frequency generators of 150 and 400 kilowatts, respectively The 100-kilowatt transmitter, a spark set, is still in use, being employed in conjunction with the 150-kilowatt high-frequency alternator set for the time signal and meteorological, as well as the transcontinental, services The 400-kilowatt set is serving as the transmitter for the overseas traffic.

Radio Messages to Your Office.—By the use of the telephone lines radio messages from stations overseas can now be automatically relayed to your office in any part of this country without going through the hands of the operators at the wireless receiving station, according to the engineers of the Radio Corporation of America. In a short time an operator will be able to tap a telegraph key at Seattle and his message will be relayed to the wireless station at New Brunswick, N. J., and thence flashed across the Atlantic to Europe An amplifier is used at the receiving end to make the sounds as clear as possible Obviously, a remarkably clear telephone line must be used in order not to distort the short and long telegraphic buzzes

Pocket Book Radio Set.—A radio receiving set shaped like a small book has recently appeared in England and has attracted considerable attention because of its novelty It operates on the variometer principle, with the covers of the "book" more or less closed so as to change the wave length of the receiving circuit. A crystal detector is included in the backbone of the "book" and the windings are inside the covers This little radio set is said to be quite effective on an outdoor temporary aerial. It has a range of from 600 to approximately 2,500 meters A pair of telephone receivers is used in conjunction with the "book"

Conductor-Directed Radio.—The Telefunken Company in Germany has developed into commercial form a system for wireless telephony especially adapted for intercommunication between high-tension stations at great distances. The signals, talk, etc, are not transmitted by ordinary wireless, states *Electrical World*, but the property of a conducting wire to direct the electromagnetic waves and thus cut down energy dispersion is made use of in the following way: An ordinary set for wireless telephony, with vacuum tube oscillators for producing continuous oscillations, feeds into a small antenna hanging between two transmission-line poles parallel to the high-tension conductors At the receiving end of the line there is a similar antenna connected to wireless telephone receivers. Two-way communication may be obtained either by using two antennæ at each station or else by coupling to the same antenna one receiver and one transmitter tuned to different wave lengths Experience shows that the energy will follow the transmission conductors without much dissipation so that very great distances may be covered with a quite limited primary energy

Science

$1,000 for an Essay on Roentgen-Ray, Radium or Radioactivity has been offered by the American Roentgen Ray Society

A Nine-Foot Skeleton.—On opening a mound near Greensburg, Pa., the curator of the Carnegie Museum of Pittsburgh, Dr Holland, unearthed a skeleton between eight and nine feet tall The mound was 100 feet long and more than 12 feet high The most interesting feature in the recent excavation was the mummified torso of a human body at least 4,000 years old The parts of the skeleton were shipped to the Carnegie Museum

A Museum Genius.—We learn with regret of the death of Dr F J V Skiff, director of the Field Museum of Natural History in Chicago Though not a scientific man, he showed the most wonderful ability as an organizer and executive of museums and his advice was widely sought He began life as a newspaper man He was Deputy Director General of the Columbian Exposition and at its close he succeeded in raising funds to purchase the Fine Arts Building and also bought many of the exhibits Marshall Field left $5,000,000 in his will for the new building the museum now occupies

Human Palaeontology.—The Institute of Human Paleontology founded by the Prince of Monaco was recently opened in Paris The previous studies of Prince Albert of Monaco have been along the lines of marine biology and oceanography, but he has also been interested for over twenty years in prehistoric man and he has financed many exhibitions which tended to throw light on the character, art, life and environment of prehistoric man The building was approaching completion when the war broke out and it has now been declared open The endowment is 2,000,000 francs

The Swiss Lakes Disgorge Relics.—The recent drought in Switzerland has lowered the lakes so much that archaeologists are having a great opportunity to examine the old lacustrine or pile dwellings which date back to the Stone Age Old pottery is being discovered in two lake dwellings revealed on the shores of Lake Neuchatel, says a cablegram to the *New York Times*, and hundreds of piles in perfect preservation and on which these dwellings originally rested are now clearly visible Many persons have volunteered help for excavating the remains of these ancient dwellings, which, according to Dr. Kellerchief the Swiss authority on the subject, ceased to be inhabited about the first century of the Christian era Numerous boats, which apparently were wrecked and sunk in past times, are now visible.

Geography Comes into Its Own.—Clark University, Worcester, Mass., is to have a "School of Geography" Geographical Research may be regarded as one of the useful products of the war, as the American people now have an international point of view Our further growth, perhaps our peaceful existence, depends on our judgment in dealing with the other peoples of the world Research work in the field of geography is very much needed all over the world, so this "School" innovation will be warmly welcomed by thinkers Graduate geography is the keynote If it had not been for the books and maps of the American Geographical Society, we should have cut a very poor figure at the Versailles conferences This Society will also establish a School of Surveying under the direction of the celebrated explorer, Dr Alexander Hamilton Rice It is proposed that graduates of the school shall be engaged in part in field surveys of high quality from which there will result improved topographic data for the regions selected for geographic study

Even State Seals Do Move.—The State of Kansas is no longer satisfied with the old seal, showing a log cabin with a farmer walking with a plow of the vintage of 1850, while in the distance is an immigrant train going down the trail, and a primitive steamboat cleaving her way through a rippleless river The new seal calls for an eight-shovel tractor plow, a twelve-room house in place of the log cabin, a twin six touring car instead of the ox-train and a limited train to replace the steamboat on the Kaw The Latin inscription is all that remains after the wave of progress has passed over the seal. We are used to such innovations in postage stamps, but such liberties taken with a State seal are unheard of These monstrosities of the die sinker's art are very awful and we hope that other State officials will take their pen in hand and draw new designs likewise It is a strange fact that the seals of Connecticut, Maryland, Massachusetts and New Hampshire do not bear their names plainly in English, if at all, nor does the Great Seal of the United States.

Engineering

A Large Indian Undertaking.—A water supply scheme is being carried out to provide water to the Jharia coal fields in India The plans include a masonry dam at the reservoir, filter beds, a main aqueduct (which includes a tunnel 2,200 feet long through rock) and underground reservoirs

Light Railways in New Zealand.—The Minister of Public Works announced in his annual statement to Parliament that the proposal to construct privately owned light railway lines in different parts of the Dominion to connect up rural sections with the Government main trunk line would be encouraged and efforts made to push the project The construction of these lines will call for a large amount of material as well as construction machinery and rolling stock

Disk Bearings for Railroads.—It is reported that the Swedish State railways recently placed an order with a native company for car axles, bearing boxes of cast iron with disk-bearing stamped cylinders and nuts, and it is not believed unlikely that this order will be the forerunner of others It is expected that disk bearings will soon come into general use upon Swedish railways It is stated that extensive trials were conducted between Stockholm and Goteborg before it was decided to adopt these bearings

Increasing Use of Concrete for the construction of dwellings is noted in various parts of the world where lumber is not over plentiful especially lumber suitable for building purposes The manufacture of concrete blocks with which concrete houses may be built with speed and economy is attracting much interest in even such remote districts as British Malaya as a means of relieving the house shortage It is reported that several municipal bodies are erecting the necessary plants for turning out these blocks

Wooden Buildings in Europe.—The serious housing shortage in several European countries has caused the extensive introduction of wooden houses Stone and brick are the favorite building materials of most European countries, and Europeans do not take kindly to wood except through dire necessity Were the exchange more favorable, there is no doubt but that heavy orders for ready-cut houses would be placed with American manufacturers As it is, the demands of Europe are being met by French, German and Austrian manufacturers

Calcutta's Port Improvements.—Facilities of access to the port of Calcutta will be greatly improved by the construction of the Grand Trunk Canal According to an issue of *Finance and Commerce* the canal will be 22½ miles long and between 250 and 400 feet wide, extending from Baranagar to Kulti The canal will include an inland harbor at Manicktolla, which will relieve the congestion on the Hooghly The harbor and its connected basins will provide a frontage of nearly 14 miles and it is believed that these facilities, and the reclamation of a large waterlogged area in the vicinity of Calcutta will afford an avenue for the expansion of the city and the creation of a new industrial center in the neighborhood

Compulsory Labor for Engineering Work.—According to information from Sofia, Bulgaria has passed a law by which labor is obligatory both for men and women This labor can be utilized in many ways, including the construction of roads, railways, canals, aqueducts, improvement of rivers and streams, installation of telephone and telegraph lines, preparation of various building materials, the planting and exploitation of forests, work in the various domains of the State, districts, or communes, cultivation of kitchen gardens raising of silk worms and of bees and cattle, fisheries, work in mines and factories, conservation of food products, weaving, etc The demobilization of the Bulgarian army by virtue of the recent treaty has rendered this law necessary

Pittsburgh's Vehicular Tunnels which are to pierce the South Hills will be the largest highway tunnels yet built, with a length of 5,715 feet Ventilation arrangements are of special interest as this is the first long tunnel in which automobile exhaust has had to be dealt with There are two tubes, each providing for two lines of traffic with space for street cars the traffic in a tube to be all in one direction The maximum estimated traffic is 1,690 vehicles per hour in each direction, mostly passenger vehicles Ventilation plans are being based on special tests, conducted by the U S Bureau of Mines, of automobiles for carbon monoxide emission, and of the susceptibility of human beings to that gas Air will be blown in at one end by lateral nozzles in the direction of traffic A pumping plant for each tube distributing normally 200,000 cubic feet over the 468 square feet of cross section will give an air current velocity of six miles an hour

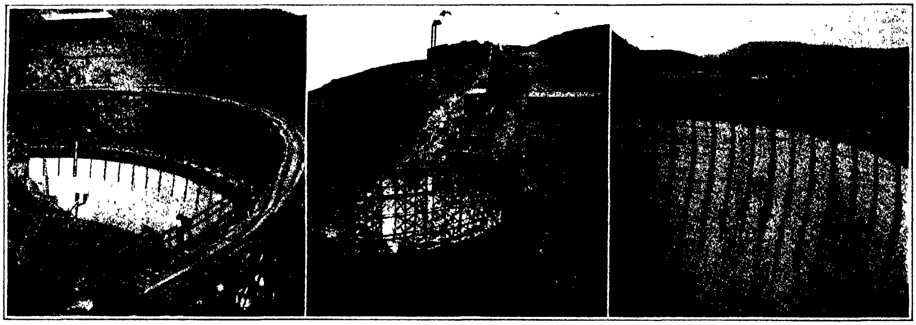
The Falsework for a Big Dam

Some Unusual Trestles Employed in This Department of Concrete Construction

By J. F. Springer

ONE of the hindrances to a still greater use of concrete is the expense of the auxiliary construction. Thus, the work may be so planned that a very heavy expenditure will be required for the forms. Or, the method of supplying concrete may involve a great outlay for trestles or other auxiliary construction. But engineers are driven to invention under stress of necessity and now and then develop a system of operating that tends to cut down the cost. Two recent cases illustrative of rather novel methods of dealing with the trestle work problem have occurred in the Far West. Doubtless the pressure of costs contributed to the adoption of these features of the methods of handling the work.

Both instances relate to single-arch dams. Such structures are built with the convex face upstream, the object in view being to resist the hydrostatic pressures by means of arch action. The horizontal thrust of the water is not at all unlike the vertical load on an ordinary arch. Where the site is a V-shaped canyon having pretty steep sides, the single-arch dam may well be considered as possibly the best type of dam to use. Where all the conditions are favorable, a single-arch dam is apt to be quite economical because of the reduction of concrete made possible by the replacement of the mere weight by the arch action of the structure. However, in order to take full advantage of the economies possible with the single arch, it is necessary to manage the curvature with some precision. Naturally, this requirement will transfer itself to the forms. In short, the proper shaping of an arch dam gives rise to demands that can only be met by a skilful and precise construction of forms.



Three views of the Warm Springs dam, two during construction and the third when nearly complete, showing the huge trestle employed as an auxiliary in the work of erection

Recently a hydro-electric power development in California required the construction of a dam to impound water. It was decided to erect a single-arch structure. On the upstream face, the height was 108 feet, and the radius of curvature of this surface was 205 feet. The construction was facilitated by a rather novel use of trestlework. When the foundation had been completed, a great trestle structure was run up. It was so set and so shaped as to inclose the space which the dam was to occupy. It was to provide not only a means of delivering concrete for the dam but also a backing for the forms whose duty it would be to give shape to the faces of the concrete structure. The concrete was delivered at various higher and higher levels as the concreting went on. The mixing plant was set on the hillside a short distance upstream from the dam. Its level was selected so that the feed hopper could readily be served from a track which connected with the stone crusher on the downstream side of the dam, and so that it might discharge by gravity to the lower levels of the dam. The higher levels would be served differently. An elevator tower was erected close by the mixer. By means of it, concrete could be hoisted to proper elevations and then delivered to selected levels of the trestlework. At these levels, tracks were laid and on these hopper cars run back and forth. These cars were hauled by gasoline locomotives and delivered their contents of concrete through openings between the rails to chutes which led to the proper delivery points. Naturally, gravity carried the concrete down the chutes whose maximum drop was limited to about 50 feet. The concrete would often go with a rush, but it is understood that the consequent violent delivery to the mass of concrete already in place tended to a consolidation, and that the new concrete did not tend to separate into its constituents as it flowed along.

The utilization of the trestle as a backing for the forms was carried out substantially as follows. In setting up the trestle, the various bents of trestle posts were so arranged that the batter post would at no point be closer than 1 foot to the concrete surface that was to be. By locating the bents at intervals of 15 feet and predetermining for every 10 feet of height the precise distances between batter and concrete, the bents were suitably set. The distance between batter posts at the bottom was a maximum of 30 feet and at the top an interval of 10 feet. It will be understood that this trestle was erected to the full height at once and stood upon its own feet, as it were.

The second instance of the rather novel use of trestlework is to be distinguished from the first in that the feet of the posts did not rest on anything at all. They straddled the partly constructed dam and, since the legs spread somewhat, support was supplied to their inner sides by the concrete surfaces and by certain anchors in the concrete. This account applies particularly to the trestle used in building the upper half of the dam. The illustrations show pretty clearly how the trestle rode the masonry.

This structure, the Warm Springs Dam, is located in the eastern part of Oregon and forms part of an irrigation system. Some 40,000 acres of land are to be additionally supplied, or else altogether reclaimed to farm use, by the proper utilization of the 170,000 acre-feet of water it has the duty of impounding. However, it is not yet certain what is to be done with a certain portion of the water. It may be used for a part of the said 40,000 acres, or it may be sold to an adjoining district.

From the underlying rock to the crest, the dam has a maximum height of some 81 feet or more. At the base it is only 27½ feet thick and near the crest only 8 feet. This is a very thin section, and is in marked contrast to what a gravity section would show. However, in 1916, when the dam was yet in contemplation, it was estimated that a single-arch structure would cost about 93 to 95 per cent of what would be the expense for the ancient type. The gravity type was at that time recommended, the excess cost being so moderate. However, construction costs kept on advancing, so that the advantage of the single-arch type became quite decided.

The new dam spans the gorge of the Malheur River and forms a circular segment of perhaps 140 degrees. It stands upon bed rock, but not exactly at the site originally determined upon. The preliminary work of excavating for the foundation indicated a deeper level for bed rock than was ultimately found necessary. That is to say, it was discovered that by shifting the site a little upstream, bed rock would be found closer to the surface. In constructing the dam, there has been recognition of the possibility that eventually the foundation rock may need treatment to render it impervious to water. Test holes put down seemed to indicate that there were no open seams. This tightness was deduced from the fact that in no case did water forced down through hollow bit and drill rod fail to reappear, when the hole was at the time in the bed rock. However, in case leakage develops after construction, there will still be a remedy at hand. In the body of the dam near the downstream face a series of vertical holes has been arranged. These are at intervals of 6 feet and are lined with 2-inch piping. In case of need, through these holes drilling may be carried on and the bed rock pierced for a distance. Then, Portland cement grout may be put down under practically any pressure desired up to say 1,000 pounds per square inch or more. This arrangement of drilling and grouting pipes is something like the case of a fairly tall building on Broadway, New York, where the jacks are already in place, if the structure, which is a pretty narrow one, should at any time show signs of uneven settlement. In both cases, the remedy could be applied, however, even if the precautionary measures had not been taken. Concrete may be bored by core drills as readily or more readily than granite, and jacks can be set at any time. However, with tubes and jacks in place, quicker action becomes possible.

There are two principal types of design for single-arch dams. In the one, the central angle included by the arc at one level is the same as the central angle included by the arc at any other level. Such dams belong to the constant-angle type. In a V-shaped canyon, with the span becoming less and less as the bottom is approached, the curvature necessarily becomes sharper and sharper because of the requirement that the central angle included shall not vary. In the other variety of design the radius of curvature once established is maintained from base to crest. In the present case, the dam is of the latter type, the degree of curvature being kept constant or substantially so. All the foregoing relates to the upstream face, the surface which receives the load. The single-arch dam of constant radius presents to the impounded water a cylindrical surface, while the dam of constant relative length of arc presents a face which deviates from the vertical and projects more and more upstream as the span decreases toward the base. In one of the views, the truly cylindrical form of the convexity is plainly apparent. The dam is quite vertical on this

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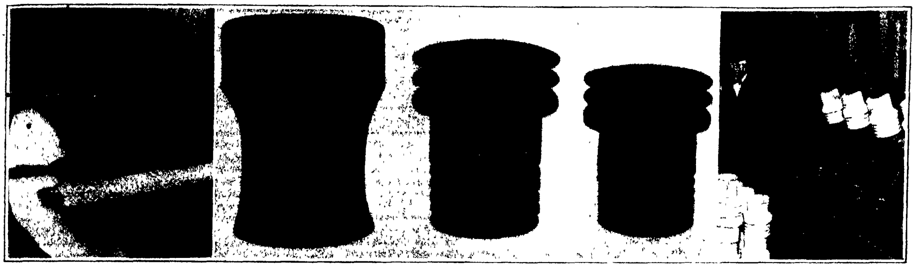

Left Filling a die with porcelain ready for stamping into a wall-switch base *Center*. Three stages of a large insulator—the porcelain blank, the same cut to shape, and the finished insulator after firing The shrinkage in firing has to be calculated to the 64th of an inch *Right* Testing insulators under a current of 75,000 volts The wavy white lines on the insulators of the lower row represent the effect on the photographic plate of electric sparks running over these pieces

Making and testing porcelain insulators to keep the electric current where it belongs

Making Electric Insulators of Porcelain

By Ralph Howard

MILADY gazes admiringly at the china that reflects the light from the electric dome over the dining room table, and wonders how such marvels of ceramic art can be wrought But she gives no thought to the humble porcelain insulator—the Cinderella of the family—without which there would be no electric light in its modern form It may seem that almost anyone could mold a porcelain wall-switch base, a cleat used in wiring buildings, or some of the simpler forms of insulators. But when it comes to making them so that after the shrinkage that results from subjecting them to a temperature of upward of 2,642 degrees Fahrenheit, they will still be within the dimensions required, it is not so simple. Nor is size the only thing that has to be considered The porcelain must be so mixed, molded and fired that it will withstand, in some cases, hundreds of thousands of volts without breaking down and allowing the current to pass through it

Porcelain is made of potters' clay, ball clay, feldspar and flint, the two latter being in the form of fine powder These are mixed with water the coarse particles strained out, and the resulting cream-like batter goes to the filter presses where most of the water is pressed out and it emerges as solid, damp cakes

There are now two methods of procedure, the dry process and the wet process The dry process is used in making the devices to insulate the lower voltage currents—such as, for instance, building-wiring equipment—while the wet process, which permits making a denser structure, is employed for insulators for high-voltage power-transmission lines, and in transformers, oil switches, etc

The making of wall switch bases, cleats, and other small porcelain insulators is a fascinating process The damp cakes that come from the filter press are dried until just enough moisture is left to press them Then they are reduced to a loose, damp powder, and this is dropped into oiled dies shaped according to the design of the article to be made Long rows of machines, each stamping out a neatly molded piece at the turn of a lever, mold thousands each in the course of a day The insulators are taken from the press and placed in neat rows on pallet boards and dried by steam anywhere from a few hours to several days. Then the little rough edges or burrs are removed and the insulator is ready for glazing

In making wet process porcelain, the cakes from the filter press are given a kneading that eliminates the air and mixes the mass together From the machine which completes this process it comes in the form of a cylindrical mass, ready to be fashioned into any desired shape.

Some is put into a plaster of paris mold and pressed into the pattern wished Another piece will be placed on a horizontal wheel operated by a motor—an adaptation of the ordinary potter's wheel When it is set on the wheel it is just a plain, ordinary looking cylinder of yellowish porcelain But under the manipulation of a skilled operator it quickly takes on a graceful appearance as shown on our cover The touch of a little implement cuts a series of grooves, or perhaps a continuous thread, in the side, and ribbon like shavings of porcelain fly from the article being turned, crumbling as they fall When the work is done, what was a mere cylinder has become an accurately measured insulator, conforming to careful specifications

Where a curve conduit or pipe is wanted the process is simplicity itself Liquid porcelain mixture is poured into a plaster of paris mold shaped like the outside of the conduit desired The plaster of paris absorbs the water from the mixture adjacent to it, leaving a shell of porcelain next to the mold The water in the fluid porcelain farther away from the sides of the mold is not absorbed, and hence the mixture remains in a liquid state When the walls of the conduit are sufficiently thick, which depends on the length of time the mixture has been in the mold, the fluid is drawn off and the conduit is taken from the mold and dried

Great care has to be used in the drying The porcelain must dry evenly, and therefore not too rapidly Steam is turned into the drying machines to insure sufficient humidity Gradually the amount of steam is decreased and the heat is increased Thus the outside is kept from cracking and the drying process proceeds uniformly throughout the article

Insulators made by the wet process are, in some cases five and six feet high and upward of two feet in diameter The largest are not, however, made in one piece. Sections are turned out and then piled up as the housewife stacks plates and the heat in the kiln when they are "fired," fuses them into one solid piece

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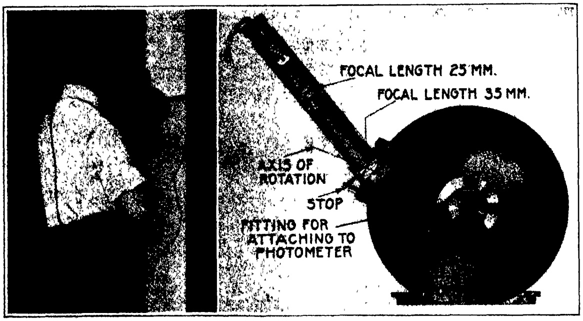


New instrument for measuring the light reflected by room walls, and the manner of its use

A Measure of Interior Lighting

By S. R Winters

A NEW instrument for measuring the light reflected by room walls, technically described as a portable reflectometer of the absolute type, has been designed by A H Taylor, until recently associate physicist of the National Bureau of Standards An achievement already credited to the device, resulting from experimental work for the government, is that of giving additional proof as to the light reflecting capacity of magnesium carbonate The value of a particular block of the substance was proven to be 99 per cent whereas the previously accepted figure was 88 per cent

The reflectometer simplicity being one of its virtues was evolved on the theory that if a light is projected onto the inner wall of a small hollow sphere, painted with a diffusely reflecting white paint, it can be shown that the illumination of the surface by reflected light only will be equal in intensity at all points A small portion of the surface is cut away, leaving a hole over which the surface to be tested is placed At another point on the sphere, 90 degrees from this one, there is a small hole through which the opposite wall of the sphere is viewed by means of a portable photometer The spot under observation is screened from the test surface by the use of a small opaque screen Therefore, when the light is projected on to the test surface, it must be reflected from it and from the sphere walls once each before any of it can reach the observation point

The newly designed instrument for measuring the light reflected by room walls consists of a lighting tube, capable of being set at an angle to the sphere surface, rotating about an axis normal to the surface of the sphere Such an arrangement permits the direct light to be thrown on the test surface or the sphere wall as may be desired An efficient lens system affords a narrow beam of light without scattered rays A uniform, sharply defined spot of light, 2.5 centimeters in diameter is the result, thereby requiring only a small opening A 2.8 volt opal-back flashlight lamp is used in the tube Its low voltage makes the instrument of a portable nature, and possibly adaptable to any reliable type of portable photometer The elimination of the battery meter set and the substitution of a three-cell flashlight dry battery, and miniature resistances would further contribute to the compactness of the reflectometer

According to claim, the superiority of the absolute type of instrument over one giving relative values is in the non-requirement of a standard surface and the unnecessary qualification of lamps or sphere surface remaining constant from day to day Experimental work with the new reflectometer

(*Continued on page 219*)

Brief Facts About Money

With a Suggestion for Making It Better Able to Perform Its Work

By Charles E. Duryea

WITH the most money per capita we have ever had, we find today a very high interest rate and a shortage of money, which results in unemployment, slack business and failure to get the profitable trade a large part of the world is begging us to take. Why are these things? A few facts about money will explain.

Money—paper money—is an invention, designed to transfer wealth. Money, by replacing barter, speeds up business. It is the great business facilitator. It may rightfully be classed with the mail, telephone and telegraph services and with roads, streets and canals. But too often we think money the concern only of the money handlers and fail to know for ourselves whether we are getting from it the service it can and should render.

When the available trails and waterways failed to carry our commerce we built larger and additional ways. So with every aid to business except that most universal one—money. Why not with money? Because few people understand its proper function. It was near the end of the last century before our people regarded paper as proper money, and only in this century have we learned that paper money, issued by a sound and honest government and secured by proper redemption provision, is the best money—better than coin. In every crisis from time immemorable coined money has taken flight and left paper money to do the work.

We have rightly learned that the Government should print money, protect it from counterfeiting, provide for its redemption and in several ways advance the interests of all. These things cannot be so well nor so safely done by individuals nor even by States, as the unsatisfactory experiences with State banks of earlier days show. The Federal Reserve and Farm Loan acts are great steps forward toward a proper supply of money but they leave much to be attained. What more can be done?

It is axiomatic that neither men nor nations should have more than they produce—the results of their labors on their natural wealth and equally axiomatic that men willing to work in order that they may secure what they desire should not be deprived of the opportunity. Yet how often do we find great lines of unemployed and factories and farms idle. Truly we then need a business facilitator and the greatest of all is money.

Money was originally simply a commodity that bartered with great ease. Because the farmer did not need shoes, the shoemaker traded his shoes for a piece of gold and traded the gold for the farmer's grain. The farmer in turn traded the gold for what he desired. This illustrates two things—that money facilitates business and that one piece of money will serve for many transactions. Many commodities have been used for money.

In the development of this invention the accepted commodities became fewer until gold has been generally adopted. All these commodities had faults, such as unhandiness, depreciation, counterfeits, etc. Gold has fewer faults than most but it is scarce, too scarce to meet the money needs of the world. If it was not scarce it would be less valuable, so even greatly increasing its quantity would not help. Its value is fixed by its use in the arts. It fluctuates in value just as does any other commodity but since a legal dollar is 23.22 grains of gold this fluctuation cannot be stated in dollars.

If we could make gold from some cheap substance its value would fall at once. Clearly then gold money and money based on gold is at the mercy of the gold miner or the accident of gold discovery. Many attribute the dark ages to lack of money to do business with.

Spain's American gold was one of the great influences that set Europe ablaze with business energy and made Spain master of the world. Every discovery of gold has brought a business boom. The great progress in every line of the last generation has been preceded by a rapid yearly increase in the production of gold. Many are the evidences of this fact. Space does not permit giving more.

The world did not need gold but money. It clamored for gold because it used gold for money. That is the case today. Lacking gold we use "credit instruments." It is clear that there is not and never can be enough gold to serve fully our money needs. If there were more gold it would have less value. It is also clear that one unit of money will serve to facilitate many business exchanges so there will ever be far more commodities than there is money. Further in our attempts to provide paper money based on gold we have constantly reduced the gold set aside to redeem the paper until we are close to the limit of safety, while other nations find their paper issues far beyond any possibility of redemption. Clearly it is time to set our money right so that world business may be facilitated and we may get that prosperity rightfully ours.

The way to do this is easy but like all good things it is so simple that it is rejected by the very people who should be the first to accept it. Instead of basing our money on one agreed commodity which cannot be of sufficient amount, we should base it on an agreed quantity of all standard commodities. These are certain to exceed our needs many times so there need never again be a shortage of money. And nations having no gold can still have a sound money. We should do this now.

Today the purchasing power of a dollar is that of 23.22 grains of pure gold, because a paper dollar can be exchanged for this quantity of gold. For 25 years past this purchasing power has been falling. "Prices have risen." The schoolma'am who banked $1,000 ten years ago cannot buy, with the principal and accumulated interest, so much today as she could then. Our wrong system has robbed her. She put into the bank a certain purchasing power. In all honesty she should get back that purchasing power plus an agreed addition for interest, should she not?

MONEY, next to language, is our most used institution. Mr Duryea, whom many of our readers will recognize as one of the pioneers of the automobile, has ideas on the nature of money and the way in which money problems should be met, which, while he is certain that they are right, he recognizes are rather controversial in their nature. We have agreed to let him make these opinions public through our pages, and he has agreed to attend to all the controversy which may arise from such publication. If you don't agree with what Mr. Duryea says, therefore, don't write to us about it; write to him, at 3528 North 18th St., Philadelphia. Some of the more significant comments which he receives he will probably pass on to us for appearance on our correspondence page; but the immediate consequences of the present article are to be on his head and not on ours.—THE EDITOR.

In years gone by the workman hired to work for, say, $2 per day. His family budget permitted him to meet their needs with this wage. But rising prices changed this. He had to have more money. To get it he "struck." His cause being just, he won. The employer to protect himself added a larger margin to his price. Prices again rose and again the worker "struck." Twenty-five years of this resulted in a constant turmoil with much waste and industrial warfare almost constant. Then the World War made matters still worse. Surely we have no right to expect otherwise.

Prof. Irving Fisher of Yale offers us a plan—not new with him and certain to be adopted some day. He would base the dollar not on gold but on a selected list of standard commodities. One such list of over 300 commodities is made by the Bureau of Labor. The average quantity used yearly by the average person is known. The price multiplied by the quantity gives the base figure. The average of these products gives an "index number." If this index number rises one per cent it is clear that the dollar should be made one per cent bigger so it may still buy the same quantity of these standard commodities. To make this dollar do this we must add to the gold it represents. In other words change from month to month or as often as need be, the legal amount of gold that constitutes a dollar. Since there is little or no gold in circulation this is a matter of law and not of coining. But it gives us an honest dollar; one that retains its buying ability. Both employer and employe can work in peace with a definite purchasing power. Further details of this can be had from Professor Fisher's books and magazine articles.

"But we cannot redeem in 300 commodities," you say. Truly. Nor do we need to. As each month the index number is published any one can know the quantity of gold constituting a dollar and our dollars may as easily be redeemed in this quantity as in the present quantity. The Fisher plan simply separates the two requisites of money. It proposes to measure money by the index number and redeem it in gold and its value will still be expressed in gold but that value will show the fluctuations which gold cannot and does not escape. We will then know what we are about instead of—ostrich-like—trying to avoid seeing that gold does fluctuate.

"But," again you ask, "if we redeem in gold how may we safely create more money than we now have?" A proper query. Having separated the purchasing power from the expression of value by basing one on the index number and stating the other in gold we at once see that paper money is something to exchange for commodities and not for gold only and that it would be just as satisfactory for our Government to redeem a dollar with silver or tin or any nonperishable commodity provided that the commodity given will, on the day of redemption, exchange for the then legal amount of gold, in the open market. By such an arrangement we may for the first time in the history of the world have as much money as we need and know beyond doubt that it can be easily redeemed as fast as presented by valuable commodities and in fair and honest amounts. This certainty would quiet any fears for the stability of our money. It would permit issuing as much money as we need, thus lowering interest rates. How low one need not say. In times past when money was plentiful our Government has borrowed as low as 2 per cent. Since the war began call money at New York has been as low as 1½ per cent. Certain it is that such rates would boom business in every line and would make our great land the farm, factory and bank of the world. It would help our producers to finance their customers in the war-stricken and less developed parts and start a flow of goods our way to meet the interest payments as well as pay the principal. It would benefit the world and show them how to get on their feet with financial soundness. There has never been a time when it was needed so badly and upon the people of the United States the burden rests. The ones who are making great profits from high interest rates can hardly be expected to take the first step.

When we have "Stablized the $" as Fisher proposes and arranged for ample and certain redemption we may take another step—direct issue to the user, provided he gives ample security. We have learned the value of free streets and roads. We carry the mails practically at cost, to facilitate business. We should encourage the small producer on farm and in factory and also the home owner by advancing money, amply secured, at the lowest possible interest and on time to suit.

This would make owners out of renters, solve the housing problem; correct the ever-growing labor problem by making proprietors of the more progressive workers; set at work many who now live by owning; and free much private money from the soft snaps it now enjoys and send it hunting investments to the ends of the earth. No single simple change offers such gains as this improvement in our money.

Cadmium in Brass

MUCH work has been done in the United States on the question of cadmium in brass and we now have the opinion of a French investigator writing in the *Revue de Metallurgie*. The conclusion which he has reached from studies upon alloys containing cadmium up to 5%, copper 70%, and zinc from 30 to 25% are:

First, that 1% of cadmium in brasses containing from 60 to 70% of copper has little, if any, effect. Resiliency suffers, however, if more than 1% of cadmium is present.

Second, changes noted in the mechanical properties are thought to be due to the probable occurrence of cadmium uncombined in the alloys.

The Einstein Prize Winner

WE had held out the promise of a biographical account of Mr. Bolton, the winner of the Eugene Higgins prize of $5,000 for the best popular essay on Einstein's theories of relativity; and we are able to present a performance which runs past the promise. In response to our request for a few details, Mr. Bolton has supplied an autobiographical sketch which we are moved to print just as it comes to us. Mr. Bolton says:

"I was born in Dublin in 1860, but I have lived in England since 1869. My family belonged to the landed gentry class, but I owe nothing to wealth or position. I was in fact put through school and college on an income which a workman would despise nowadays. After attending sundry small schools, I entered Clifton College in 1873. My career there was checkered, but it ended well. I was always fairly good at natural science and very fond of all sorts of mechanical things. I was an honest worker but no use at classics, and as I did practically nothing else for the first four years at Clifton, I came to consider myself something of a dunce. But a big public school is a little world. Everyone gets an opportunity, often seemingly by accident, and it is up to him to take it. Mine did not come till I was nearly 17. As I was intended for the engineering profession, I was sent to the military side of the school in order to learn some mathematics, at which subject I was then considered very weak. This was certainly true, as at that time I barely knew how to solve a quadratic, I was only about halfway through the third book of Euclid, and I knew no trigonometry. But the teaching was inspiring, and I took readily to mathematics. One day it came out that I had been making quite a good start with the differential calculus on my own without telling anybody. After that all was well. I left Clifton in 1880 with a School Exhibition and a mathematical scholarship at Clare College, Cambridge.

"After taking my degree in 1883 as a Wrangler, I taught science and mathematics at Wellington College, but I was attracted by what I had heard of the Patent Office and I entered it through open competition in 1885. During my official career I have been one of the Comptroller's private secretaries and I am now a Senior Examiner. During the war I was attached to the Inventions Department of the Ministry of Munitions, where my work related mainly to anti-aircraft gunnery. I have contributed, and am still contributing, to official publications on the subject.

"I have written a fair number of essays on various subjects, even on literature, but my only extra-official publications relate to stereoscopic photography. I read a paper on this subject before the Royal Photographic Society in 1903 which was favorably noticed by Dr. von Rohr of Messrs. Zeiss of Jena. I have also written in the *Amateur Photographer*.

"I have been fairly successful at athletics, and I am a member of the Leander Club."

"Feb. 14, 1921. "LYNDON BOLTON."

Current Scientific American Monthly

IN variety and number of subjects covered the SCIENTIFIC AMERICAN MONTHLY for March is unusually rich. There are twenty-six major articles and twenty-nine shorter articles and notes, in addition to eight departments which give a survey of the progress of science and technology.

The leading article in this issue is one of the essays of the Einstein prize contest. The judges, in making their selection, were obliged under the conditions of the contest to select an essay which would be within the grasp of the general reader. Naturally there were some essays which, although excellent from every other viewpoint, failed to measure down to the standards of the general reader as interpreted by the judges. Among these essays, there was one which was a most illuminating discussion for the man equipped to read it with full understanding, but which had to yield first place to Mr. Bolton's essay because it was considered somewhat above the average layman. This essay was written by Dr. Francis D. Murnaghan, and it appears in the current issue under the title "The Quest of the Absolute."

Great interest has been aroused in recent years by the discovery of paintings in ancient caves, which undoubtedly were made by artists of the glacial period. Most of these paintings have been either of symbolic nature or else have portrayed animal life. Among some recently discovered cave paintings in Spain, there are pictures of human beings done in a very realistic manner and in one or two cases there are actual portraits, although they may be regarded as "non-individual," because of the omission of details. Reproductions of some of these figures and an interesting discussion of them are to be found in the March issue.

One of the truest measures of the civilization of any race is to be found in its of traffic on water as well as on land. There are some primitive tribes which are confined to comparatively restricted regions, because they have not yet discovered or invented the simplest means for crossing rivers or stretches of water. Other tribes on the contrary have shown considerable ingenuity in the construction of bridges, consequently the bridge forms a very good test of civilization. An exceedingly interesting article on this subject describes trestle, truss, cantilever, suspension and arch bridges made by natives of such materials as they had at their disposal. These primitive engineers show, in many cases, a remarkable degree of ingenuity and technical ability.

Recently Columbia University has instituted a series of psychological examinations to test the mental capacity of students. In view of this our readers will be interested to learn what A. T. Poffenberger, Assistant Professor of Psychology at Columbia University, has to say on "Psychological Examinations." He describes practical methods of measuring vocational fitness.

The article is profusely illustrated with photographs and diagrams.

We are wont to think of the devil-fish as an octopus. As a matter of fact this name applies rather to the giant Manta, which sometimes reaches a length of 12 feet and breadth of 20 feet. The curious habits of this gigantic denizen of the sea are entertainingly described.

Lyndon Bolton, winner of the Einstein Prize Essay Contest

The coming visit to this country of Madame Curie, the famous discoverer of radium, lends particular interest to an article on "The Radium Institute in Paris" which describes that distinguished scientist's new radium pavilion and its scientific equipment.

At the present time the prevention of dust explosion is commanding the earnest attention of engineers of all classes in this country and abroad. The causes and prevention of explosion and the types of industrial plants affected are outlined by David J. Price, in which he brings out some newly discovered factors.

"Ancestors of the Liberty Motor" is the title of an interesting article by Dr. Carl W. Mitman of the U. S. National Museum. In this article he outlines the origin and development of the internal combustion engine from the latter part of the 17th century up to the present day. The article is illustrated with photographs of models in the Department of Arts and Industries of the U. S. National Museum.

M. Louis Lumière, who is well known for his work in color photography, recently presented an important communication before the French Academy of Sciences, concerning a new method he had developed for taking photographs of "solids in space." In other words, the photographs indicate three dimensions instead of two, in the manner of a relief map. This effect is produced by using a camera whose lens and plate holder, respectively, have rotary motions during the exposure of the picture. A complete description of the apparatus and a geometrical explanation of the principles involved are given.

Leonardo da Vinci, as well as being a world famous artist, showed remarkable talents as an inventor and his achievements in science and invention are described in an interesting article by A. A. Hopkins. Some of his original drawings are reproduced. An ingenius file-cutting machine, a marble sawing machine, a traveling crane and a military engine—which was the forerunner of the mitrailleuse—were among the products of his fertile brain. Leonardo was also the inventor of the suspension wheel. This article will be supplemented in the April issue of the SCIENTIFIC AMERICAN MONTHLY by another on Leonardo da Vinci as an inventor of flying machines.

A Community Ice Plant

SOME Western communities in which ice is strictly a manufactured product are interesting themselves publicly in the subject of ice manufacture. There is a type of small district or city which justifies the establishment of one local ice plant, but does not contain room for two. The operator of the one ice manufactory enjoys the nature of a monopoly. Of course, ice can be shipped in, but ice is a very bulky and heavy commodity, and its free flow between communities, in commerce, is never apt to be very great.

Many communities have protested and complained a great deal about ice prices. One community, Lindsay, in California, has acted. A local plant was on the market, and last spring the local Chamber of Commerce got an option on it, organized the Lindsay Community Ice Company, sold stock to some three hundred local people, and took over the plant. Management of the enterprise was placed with the secretary of the Chamber of Commerce.

The first season's record of this company is illuminating. It is in the centre of a district where retail ice prices, platform basis, have been up around $1 a hundred. At Visalia, ice was 80 cents at retail, at Exeter 90 cents, at Portersville and Lemon Cove, $1. At Lindsay, the community company sold ice at 50 cents a hundred.

The plant manufactured 1,000 tons of ice the past summer. Granting consumers would otherwise have paid 85 or 90 cents, the company saved them something like $7,500. At this rate, the replacement value of the plant being $20,000 to $25,000, the plant would pay for itself in less than four years.

The plant has a capacity of 1,000 tons a year, and storage space for 100 tons. The low prices have stimulated demand, and the coming year the capacity will be increased to 2,000 tons, which the management says can be easily sold. Storage room for 1,000 tons will be put in. Farmers on trading visits to Lindsay are good customers.

The past season, the Lindsay community plant manufactured ice and put it on the platform for about $3.80 a ton. Retailing ice, however, it figured it must sell for 50 cents the cwt. in order to break even.

An ice plant requires considerable initial investment. The competition of private enterprise in local ice manufacture is not keen and retail prices naturally are high. The community ice plant seems an obvious remedy for the situation, under some circumstances.

A Mathematical Prodigy

SOME years ago the London *Lancet* cited a remarkable case in which extraordinary ability in arithmetical calculation was associated with general mental inferiority, if not actual insanity. The patient was completely blind and was able to make elaborate calculations such as a square root of any number running into four figures in an average of four seconds and the cube root of any number running into six figures in six seconds; thus he gave the cube root of 465,484,375, which was 775, in thirteen seconds. These are mere trifles however, compared with the following. He was asked how many grains of corn there would be in any one of 64 boxes, with one in the first, two in the second, four in third, eight in the fourth and so on in succession. He gave the answers for the 14th (8192), for the 18th (131,072) and the 24th (8,388,608) instantaneously, and he gave the figures for the 48th box (140,737,488,355,328) in six seconds. Further, on the request to give the total in all the boxes up to and including the 64th he furnished the correct answer (18,446,744,073,709,551,615) in 45 seconds. Such mental processes are particularly interesting in view of the fact that the patient cannot have any visual memories as he has been blind from birth. The same patient can give the date for Easter in any year, in the Gregorian and Julian calendars respectively and simultaneously.

Who Shall Work the Farms?—II

The Extent to Which the Labor Shortage Persists, and the Measures of Relief Available

By George H. Dacy

LAST week Mr. Dacy presented the first half of a discussion of the farm-labor shortage as experienced last year and as promised for 1921. In this article he concludes his remarks with a few more figures that go to establish definitely how serious the matter really is, and a few suggestions from those best qualified to judge how the farmer may best find his way out of the difficulties in which short help have plunged him.—THE EDITOR.

ONE thing is as certain as the millennium. It is that you cannot operate a farm or handle farm labor on an eight-hour-day basis. If the farm operates on a short day calendar it simply involves the use of a double labor force. During the summer the average farmer has to spend from twelve to thirteen and in many cases fourteen or fifteen hours daily in the fields to handle his crops successfully. If his day is limited to eight hours, he performs only a little more than half as much work as he would do normally during the warm weather period. The rush season of haying and harvest activities emphasizes the necessity for capitalizing sunshine and daylight. These are the times when the faithful farm hands let their watches run down and do not wind them again until the period of pressure is over. During these seasons the eight-hour-a-day worker is about as useful to the average farmer as a couple of knitting needles would be to a litter of kittens. The man or boy who truly aspires to work on a farm this summer or who desires to aid in the food production operations initially must divorce himself from every shred of the idea that eight hours of daily work and employment on an average farm even occur in the same dictionary.

Dr. H. C. Taylor, in charge of the Office of Farm Management of the Department of Agriculture, who is *intimately in touch with the farm labor situation in* all parts of the country, told the writer that the feasible manner for the farmers to meet and defeat the critical farm help shortage was by using heavier machinery—as far as possible—and by utilizing the tractors which would allow one man to perform the work of two or three workers. Doctor Taylor said that Uncle Sam would work overtime in directing the labor from towns and cities to the most seriously straitened regions. He referred at some length to the bad effect which the contraction of credit has had upon the farmers' recent purchases of heavier machinery, power outfits and fertilizer. According to his opinion, throughout the wheat growing districts the labor recruiting service is organized efficiently and adapted for securing and distributing farm labor—as it becomes available—among the labor impoverished farms of its locality. The farmers' organizations, the state departments of labor and the farm bureau federations are all working for the single end of promoting and increasing production as the laudable methods of reducing existent, inflated living costs.

In conversation with Mr. Asher Hobson, Assistant Chief of the Office of Farm Management, he brought out the fact that the abandonment of farming as a profession by many boys subsequent to their release from military service was not as vital a cause of the existent labor curtailment as are the *high industrial wages and* opportunities galore for indoor jobs which are prevalent throughout the country. He said that about 1,000,000 farm boys entered the military and naval services and that anyway 50 per cent of them returned to the farms after the hostilities had ceased. If they left the farms subsequently it was only because the cities and towns afforded them better wages; their inherent desires were to remain in the rural sections.

Doctor Taylor predicts that if there is a shortage of food crops this year—and present balances are all weighed in that direction—the maximum scarcity will occur in the case of vegetables. He told me that truck farmers—and especially those in the Eastern States because ordinarily they reside proximate to cities and central markets, have experienced the greatest difficulties of all soil-tillers in their efforts to secure adequate field assistance. This lamentable lack of labor combined with congested transportation facilities which impede the movement of truck crops from production sections to consumption points have united to complicate the vegetable producing and marketing enigma. During the present season two thirds of the lower Rio Grande cabbage crop rotted in the fields because of inadequate transportation accommodations to convey the crop to the Northern markets.

On the basis of the last available census figures in 1910 there were 6,361,502 farms in the United States on which were employed 10,851,702 male workers. At that *time the total land in farms amounted to* 878,798,325 acres and of this aggregate, 478,451,750 acres consisted of improved land. These statistics indicate that one man worked 138.1 acres of land of which 75.2 acres were improved. The last estimate of the Bureau of Crop Estimates was that more than 6,717,000 farms were being operated while the supply of farm help had decreased materially. The indications are that each man or boy working on a farm this year will have to work anywhere from 85 to 90 acres of land to maintain anything like normal production.

During the war patriotic citizens over the entire country responded generously and in large numbers to the calls of the government requests for emergency labor to help harvest the food crops. In that instance the office men donned overalls and jumpers in order to produce food with which to defeat the Hun. This year they will have to duplicate their former exertions in order to provide food for their individual homes. Previously the "shock" troops served in order to defeat a vindictive and iniquitous enemy. This year they will work as diligently in order to drive away threatening food famine and the emissaries of want.

The sentiments of Mr. Gray Silver, Washington representative of the American Farm Bureau Federation, are expressive of the concern which his organization attributes to the farm labor situation. "We consider that the best mediums which the American farmers can use to combat reduction in their labor supplies are *the efficient utilization of the tractor and the plentiful applica*tion of commercial fertilizers," remarked Mr. Silver in the course of our conversation. "The acreage which is devoted to tilled crops must be cultivated as thoroughly as possible and effort should be exerted to produce high yields from the smaller areas which will be farmed this year. It is all right to increase grass seeding and pastures as well as to extend the area devoted to cover crops, but the farmer who intends to harvest these crops with live stock must take into consideration the present difficulties of financing such purchases due to the conservative attitudes of many of the banks. Similarly the contraction in credit is affecting the purchase of machinery and fertilizer.

"The Farm Bureau Federation is making particular appeal to the industries and manufacturing concerns to release as much labor as possible for emergency work *on farms,*" continued Mr. Silver. "*If the men who* are unavailable for farm work but who remain in the towns and cities will work longer hours each day, their extra service will permit of diverting many of their farm experienced mates to country labor. It really simmers down to the matter of whether or not—for example—a factory which employs 5,000 men would rather temporarily release about 1,000 of its men for farm work and ultimately have plenty of food in the markets or whether the plant would prefer to hold all its workers and abet greater inflations of living costs due to potential and drastic limitations in the food supplies."

In case of a food shortage the farmer will be the last one to go hungry as he will provide first of all for his personal needs. It will be the people in the towns and cities who will suffer. That is why it will be *only judicious management on their part to respond* as nobly as they did during the war period to the farmer's need for extra help. The farmer will pay wages in proportion to the prices which his crops will bring and the indications are that the prices will not decline for some time to come. The immediate need is to produce and harvest the maximum of crops. The marketing and distribution of these crops will logically take care of themselves under existent conditions. However, a fertile field for reducing living costs will be to improve distribution so that the spread between what the farmer receives and what the consumer pays for the foodstuffs will *be more fairly adjusted.*

Reports just received by the Bureau of Crop Estimates show that reductions of 5 per cent in the potato acreage and 29 per cent in the areas devoted to beans were already in evidence last year as examples of the curtailed production which resulted from the farm labor shortage. New York planted 97 per cent of the previous year's potato acreage; Michigan 90 per cent, Wisconsin 95 per cent; Minnesota 89 per cent, Colorado 94 per cent, Idaho 95 per cent and California 110 per cent. Aroostook County,

(*Continued on page 219*)

When we see the whole family thus on the job, we can understand why potato plantings were reported to be five per cent less in 1920 than in 1919. The ten-year-old boy, whatever he may achieve in individual cases, cannot make the same showing in the general average as a man

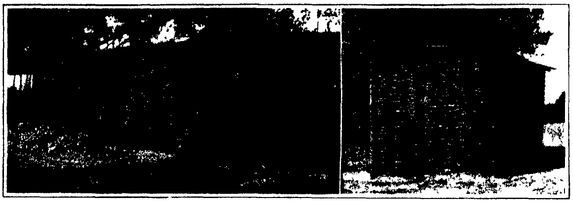
Practical and Inexpensive Farm Buildings from Willow Saplings

WILLOW saplings, because of their pliability and apparent versatility, have been put to a good many uses. From the oriental baskets and vases to the modern hot weather furniture, the willow sapling, or its close kinship, plays an important part

But one is considerably surprised, if, upon traveling a country road, he suddenly meets up with a freak farmstead, especially if it happens to be in a modern farming region, which has, as the main form of building material, willow saplings But such is the case Up in the edge of the sandhills of Nebraska one may find just such a farmstead Though primitive in style, and conflicting violently, at times, with certain *conventional* rules of carpentry, or to whatever class of building to which it is the closest related, the buildings found on the place do command the respect of the critic for their ingenuity alone Each one, save the modest cottage home, is built *of* willow saplings Double walled, with tightly packed insulation of straw and leaves, the barn, hog house, poultry house, and corn crib are as warm and storm proof as any modern frame building

When the land was purchased by the present owner he found winter coming on and lacking surplus funds at the time, sought to solve the problems of housing his stock through the cold weather Whether his ancestors were among those who wove baskets by the side *of* babbling brooks in

(*Continued on page 220*)



Two farm structures built of willow saplings, in architectural style just like the clothes hamper

The Four-Wheel Brake Again

AN automobile with brakes on all four wheels may be stopped in half the distance required if the brakes act on the rear wheels only For this reason the four wheel braking system is looked upon in many quarters as promising to be an important factor in the reduction of motor car accidents Half a dozen European cars have four-wheel brakes and another half dozen makers have announced that they will use them on their new models Recently a new fine car has appeared on the American market with brakes acting on all four wheels and controlled by a single pedal This braking system is notable in that it is hydraulically operated

The brake pedal is linked *to a master plunger from* whose cylinder flexible oil-leads run to the four brakes. The brakes are internal-expanding. A small cylinder with piston is placed between the ends of the brake shoe so that one end of the shoe is linked to the cylinder and the other end is attached to the plunger rod. When the pedal is depressed, the pressure is transmitted by means of heavy oil to the four brake cylinders and the brakes are applied Ordinarily when the piston in the master cylinder has traversed one-third of its stroke the pressure is sufficient to lock the brakes

There is a spring in each brake cylinder which automatically pulls the shoes away from the drums as soon as the foot is removed from the pedal. Hydraulic transmission of the braking effort eliminates the friction of the common types so that the new system requires no more foot pressure to apply all four brakes than to apply two brakes actuated in the ordinary way

The hydraulic system has the advantage of extreme simplicity, perfect brake equalization, and little likelihood of getting out of order, although the last point may not be fully apparent at first glance

Inasmuch as the front wheels must swing around their steering pivots as the car is guided the application *of a suitable brake linkage* is a matter of considerable difficulty, but a problem that is very nicely overcome by hydraulic means

Separate leads run from the master cylinder to each rear wheel, the tubes following the triangular brace members which run from the front of the torque tube to the axle housing ends A single tube runs to the front brakes following along the left frame member to the spring and following the spring to the axle, where the lead branches, *one going to the* right brake and the other to the left brake

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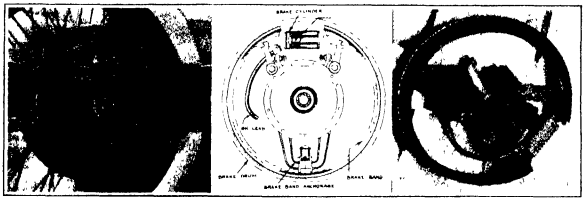
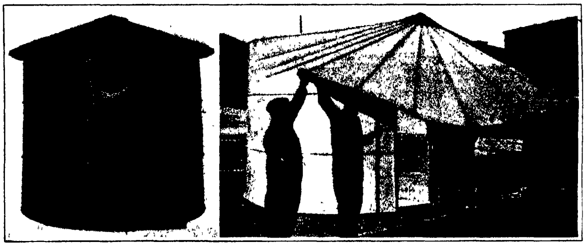


Left The brake installed, showing the cylinder between the ends of the shoe Since it is an internal-expanding brake application of pressure in the cylinder applies the brake *Center* Diagram showing the scheme of operation *Right:* The brake mechanism isolated from the wheel

The four-wheel brake that operates hydraulically

Portable Grain Storage Tanks of Metal

WE illustrate herewith a handy farm accessory manufactured by a large concern in Kansas City It is designed to take the place of grain storage of less satisfactory sorts, its particular advantages being not merely the obviously fire- and damp-proof characteristics which it presents, but equally the ease with which the steel tanks can be put up and taken down and moved about, and the facilities which are offered for filling and discharging them Man holes in roof and sides, and a large lip with a spout effect, fill the latter rôles Ventilation is amply looked after The tank is offered in various capacities, from 500 to 10,000 bushels



Steel tank for grain storage, and way in which the roof is assembled before putting it in place

A Ditch-Digging Giant

A WHEEL without spokes and hub, the mechanism consisting of two parallel iron rims held in fixed position by buckets riveted between the rims, is a brief description which suggests the novelty of a farm drainage ditching machine manufactured by an Ohio firm Fifty of these machines are in use in one county in Ohio

The rims of the open excavating wheel are supported upon four pairs of small wheels Both wheels of the pair immediately above the point where the digging is accomplished are sprocket wheels, thus permitting the application of power The buckets are open at the inner side, but close inside the rims is a metal plate covering one-half the circumference of the excavating wheel that retains the dirt in the buckets until it has been conveyed to the highest point. Here the upturned soil falls upon a belt conveyor which deposits the earth beside the freshly cut trench

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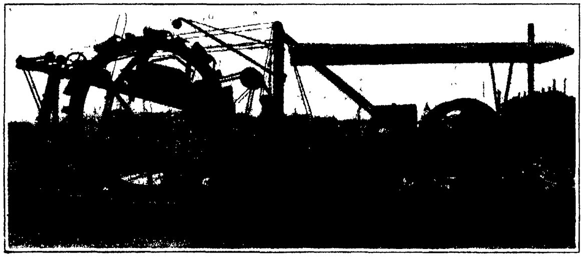
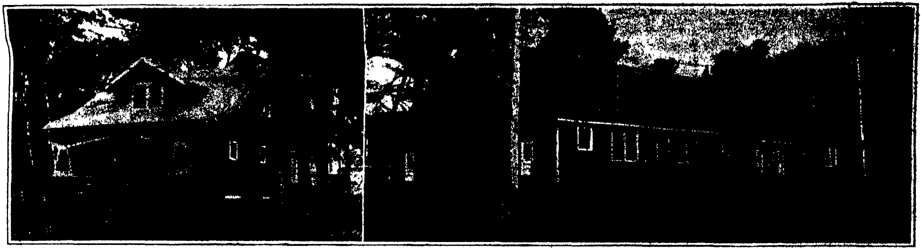


Monster drainage ditching machine of novel design



***Left:* A typical home for a factory superintendent. *Right:* The recreation hall, with a capacity of 1500**

Solving the Labor Problem—IV

Home Comforts and the Community Spirit as a Remedy for Heavy Labor Turn-Over

THE final success of that very remarkable motor, the Liberty engine, was due in no small measure to the introduction of molybdenum steel in its construction, notably for the crankshafts *This improvement* was due chiefly to Mr C Harold Wills, whose valuable work in bringing the automobile to its present high stage of development is widely recognized and nowhere more so than among his brother engineers So strongly impressed was Mr Wills with the valuable qualities of the new steel, *which had shown a marked superiority* to the best alloy steels in toughness, workability and in strength per unit of weight that he saw a long awaited opportunity to build a medium-weight moderate-priced car, which should possess approximately the same power as the so called high powered cars

It is not our intention in the present article to speak of the car, but rather to describe the initial steps which were taken by Mr Wills and his associates in framing their labor policy and building up an organization for the construction of the car

The Problem of Labor Turn-Over

Like many another engineer of prominence, Mr Wills has the advantage that to his wide technical knowledge is added an extended experience as a mechanic in the shops, with all that intimate knowledge of the thoughts, feelings and aspirations of the workman and of the labor problem in general, which comes as the result of personal, day-by-day contact He knew well that the greatest problem confronting the manufacturer was that of labor, especially in the automobile industry, where 85 per cent of the production costs is due to labor He realized at the outset that the most fruitful source of economy would be found in securing and maintaining a labor force which was so well satisfied with its surroundings that labor turn-over would be reduced to a minimum For a labor turn-over of 500 per cent in the course of a single year means that in a factory where, let us say, 5,000 men are employed, there will appear upon the payroll the names of no less than 25,000 men In other words, while the daily force is maintained at an average of about 5,000 men, the constant migration of the men in search of conditions which they hope will be more to their liking, results in the passage of 25,000 men through the shops It needs no argument to prove that high labor efficiency is impossible under such fluctuating conditions The ideally perfect situation would be one in which there was no labor turn-over that is to say, a factory in which the men that were working on January 1st were still on the job on December 31st

American Workmen Demand Home Comforts

An analysis of the causes showed that this ceaseless coming and going of men, so far as the city of Detroit was concerned, was due to the shortage of houses and to the fact that the greed of the retailers in continually raising prices practically robbed the workmen of the liberal increases which were made from time to time in their pay Undoubtedly, of these two conditions, the unbearable housing situation was the most disturbing The self respecting American workman does not like to go home *after work and find his wife and* children *cooped up in* a few rooms in a tenement house, with a minimum of light and air, and with no open spaces for recreation and no playground save the city streets for the children He realizes that the claims of his family to more decent living conditions are well justified, and in many cases it is only a question of *time* when he throws up his job and goes elsewhere for the sake of his family Mr Wills decided that the true solution of the problem would lie in building a model town well out in the country but within touch of that great center of the motor car industry, Detroit. He selected a well-wooded site on the banks of the St Claire River, where the ground is high and slopes gradually to the river Here he purchased a tract of land comprising 4,200 acres and stretching for several miles along the banks of the St Claire River

> *IF labor is to be efficient in the shop it must be comfortable and contented in the home. This is a truth which has pushed its way to full recognition and is now appreciated as fundamental Every industrial institution which has an enlightened labor policy gives attention in greater or less degree to the home life and recreation facilities of its employees. The present article shows how one company has given this matter the very first place in its broad policy of operation, building an up-to-date city for its employees before it erected its factory and put its plant in operation* —THE EDITOR.

Building a City of Contented Living

A town for the working force was built simultaneously, and indeed somewhat ahead of the factory, and as a preliminary step a general survey was made of model industrial communities in this country and abroad, particular attention being paid to the housing facilities, the width of streets, park areas and similar features The town of Marysville, as it is called, combines the best features of the English and other communities, with certain improvements suggested by the local conditions. The streets in the average English community were found to be 40 feet wide The minimum for Marysville was set for 60 feet, and one-third of the whole area was devoted to playgrounds, parks and boulevards It was decided that the smallest building lot for the working men should be 40 feet wide by 120 feet deep, so that every man could have his own front lawn and a rear garden

The general plan was laid out with the idea of providing a separate house for each family and a series of community houses for the unmarried men The workmen's houses are substantially built and are planned with a view to external artistic appearance and such internal arrangements as will lighten the duties of housekeeping. Each house is provided with a bath, electric lights, telephone if desired, and an electric cooking range, and the whole thing has been so well worked out that these individual homes have given great satisfaction to the tenants

Since a large portion of the employees in the new shops are unmarried, it was necessary to provide for them a special type of accommodations, with home surroundings suited to their particular needs. A solution of the problem was found in the community or club house These community houses, of which several have been built, each accommodate 56 men Externally, they are of simple design and show a modified colonial architecture They are built in groups around a large central dining hall which is capable of accommodating some 400 men The underlying idea in the community house system is to provide a modified form of club life and encourage the social and fraternal spirit The buildings are of two stories and they are planned on the general lines of the college dormitory An excellent feature which is greatly appreciated by the men is the provision of a large lounge room on the ground floor. It is finished in oak, with an open fireplace flanked by library shelves at one end, and has a liberal supply of tables, couches and arm chairs, all of the furniture being leather upholstered and of high quality.

The Problem of Recreation

In planning this "City of Contented Living," as it has been aptly named, it was necessary to do more than provide living accommodations. Although your average automobile shop mechanic is painfully alive to the uncomfortable living conditions of such a congested city as Detroit, he is equally alive to the advantages of city life in the way of diversified recreation, and in order to round out and complete the attractiveness of the new community, it was necessary to make thorough provision for recreation. To this end, the company built a recreation hall capable of accommodating 1,500 people, which was ready for service when the city was thrown open for occupation, and Marysville has been placed on the cir-

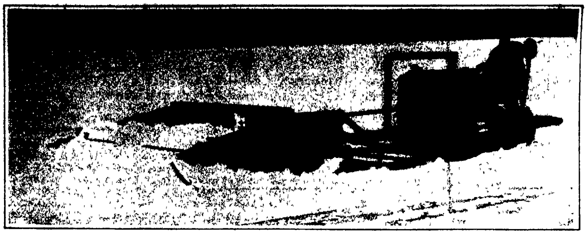
(Continued on page 230)

Community houses for unmarried men, and the dining hall

New Aids for the Ice Harvesters

TWO of the latest developments in the ice harvesting industry are shown in the accompanying illustrations. The first view shows a huge wooden scoop which is pushed along by a powerful caterpillar tractor, for the purpose of removing the layer of snow from the ice to be harvested. It is said that this machine does the work of six men and six horses, and can clear the snow ahead of an entire ice-cutting force.

The second view shows a little power boat which is being used by a New York State ice-harvesting company for the double purpose of pushing the huge fourteen-ton cakes of ice along to the ice house, and keeping the ice channel from freezing. The boat is driven by a steam engine and propeller, and is so shaped that it works admirably as a pusher. It is reported that this boat takes the place of six men who ordinarily find it difficult work to keep the ice channel open during a cold night.



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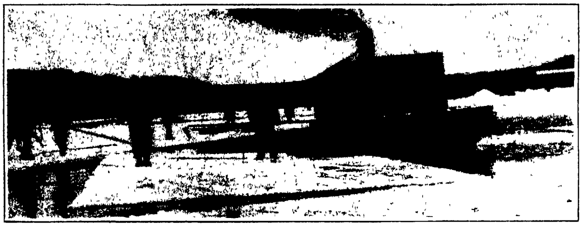
Clearing the ice field of its layer of snow by means of the tractor-driven snow plow



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This steam barge pushes the fourteen-ton ice cakes to the ice house and prevents the freezing of the ice channel

Fighting New York's Snow Storms

SEVERAL weeks ago New York had its long-sought opportunity of trying out a brand new collection of snow-fighting equipment as well as a new plan of action. In less than twenty-four hours a heavy snow storm piled up 12½ inches of snow on the streets of the metropolis, causing no little inconvenience as might well be expected.

The present snow-cleaning equipment of New York came as the result of the blizzard during February, 1920, when traffic tie-ups due to the heavy snowfall cost the merchants of the metropolis something like sixty million dollars, and the city itself five and one-half millions for emergency snow-removal work. This experience caused the city officials to revise their former snow-fighting plans, and to purchase for the purpose one hundred small caterpillar tractors, fifty large caterpillar tractors, and 212 five-ton motor trucks, together with a varied collection of push plows and pull plows.

While the officials have not as yet had an opportunity of studying and reporting the results in detail, it appears that the new equipment and the new plan have worked out admirably. The five-ton trucks have been used with push plows for keeping the important arteries open during the snowfall, while the two types of caterpillar tractors in conjunction with push plows and pull plows have cleared the city streets in a minimum of time. The small tractors, weighing 4,000 pounds, have been used with push plows and pull plows, while the larger tractors of 8,000 pounds have been used with push plows.

The present plan of action in combating a New York snowstorm is to begin work while the snow is falling and keep at it so as not to give the snow an opportunity to pile up, if possible. To this end the motor trucks, fitted with push plows, are kept circulating through the main arteries of traffic, while the snow is falling. These vehicles are followed up by the slower moving tractors, which strive to keep the main thoroughfares clear of snow, and in the case of the side streets, to clear a way through the center of the street. Meanwhile the snow accumulates in piles and ridges along the gutters, but does not interfere with traffic to any serious extent. The next step is to remove the piles and ridges and to enlarge the way through the side streets. This is carried out by means of motor trucks and men, in many instances, although the New Yorkers find that the tractors with push plows and pull plows can be used with good results for "sewering"—that operation in which snow is carried or pushed into certain sewers in order to dispose of it.

So anxious is the municipality of New York to handle its snowfalls in the most expeditious manner that it is investigating and testing all forms of snow-sweeping and snow-shoveling machines. Some excellent results have been obtained with some of these machines, and a further reduction in the number of men required to shovel snow is expected in the near future. One of the latest schemes to be tried out is the mounting of a high power water nozzle on the front of a small caterpillar tractor. Water at high pressure is supplied to the nozzle by a long line of hose trailing behind the tractor. The tractor charges the piles of snow, so to speak, and washes them away. Obviously, such operations can only be carried on in mild weather, but the results of preliminary tests are promising.

The Prehistoric Rock Paintings of Spain

THE cave paintings recently found in the eastern part of Spain are of extreme interest and certainly belong to the most surprising of all the discoveries made in the realm of primeval days. From these Spanish caves there have been obtained a number of paintings or carvings on rock, most notable among which are the large and extremely realistic pictures of animals, including the mammoth, the wild horse, the bison, the reindeer, the mountain goat, the cave lion, and some singular half animal caricatures and certain still unexplained "symbolic" characters.

Certain of the Spanish prehistoric paintings are executed in light or dark red pigments. Since these are exposed to the more or less direct rays of the hot sun they are usually a good deal faded or else obscured by an incrustation of dust. It is only necessary, however, to moisten them carefully with a sponge to see them in many cases revived in all their freshness. This application of the sponge does not injure the pictures, since the pigments, which were probably rubbed up originally with grease, have formed in the course of centuries a chemical union with the surface of the rock, so that they may be said to have actually become "fossilized." Doubtless, of course, time and the hand of man have either wholly or partially destroyed many others.

The peculiar interest that attaches to some of the Spanish prehistoric rock paintings is the fact that they contain numerous representations of the human form done in a most realistic manner. The "portraits" of human beings are usually full of life and motion, we learn from the March issue of the SCIENTIFIC AMERICAN MONTHLY, which carries a detailed article on this interesting subject. Female figures very seldom appear among them and when they are seen they are clad in long bell-shaped skirts. The male figures are always naked, but usually carry weapons and wear certain ornaments among which are very wonderful caps and "crowns" as well as armlets and knee bands, while attached to the shoulders or hips are fluttering ribbon-like decorative strips of material. Very conspicuous in these pictures are the bows and arrows with which hunters or warriors are armed.

Bridges and Civilization

BOTH from the technical and from the ethnographic viewpoint it is not without interest to study the primitive origin of bridge building, since this evidently presents a most difficult problem. Thus we learn from the March issue of SCIENTIFIC AMERICAN MONTHLY that the first bridges were undoubtedly the fallen trees lying across streams and the heavy vines

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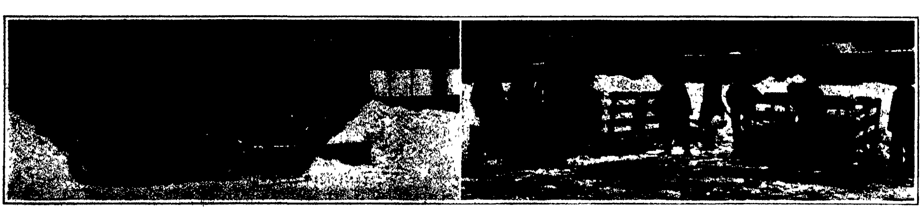

Left: One of New York's large caterpillar tractors using a push plow on a side street. *Right:* Removing snow from New York shipping and trucking district by means of electric tractors and trailers

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H E HOWE, Chemical Engineer

Glass for Ampuls

IN a recent number of the *Journal of the Franklin Institute*, Mr J E Ewe reports tests employed in the selection of ampuls which are now used in very large quantities Unselected glass may contain sufficient free alkali or release it in the sterilization process, or while the filled ampuls are kept in stock, to precipitate a portion of the alkaloidal base and unless due care is exercised in selecting the glass some may be used which will throw off splinters, especially under the stress of sterilization The first defect would result in the lowering of the efficiency of the solution contained in the ampul while the splinters of glass might result in discomfort, irritation, or even more serious results Consequently, in addition to working with ease under the flame the glass must not produce turbidity in a 1 per cent solution of morphine sulfate or 2 per cent strychnine sulfate in normal salt solution when sterilized in the ampul When a 6 per cent salt solution is sterilized in the ampul a careful examination of the liquid afterward, using a magnifying glass, must disclose no spicules or glass splinters The glass must also be tested with respect to alkalinity This is sometimes conducted by sealing water containing a few drops of phenolthalein test solution in an ampul and autoclaving it at 12 pounds steam pressure for 45 minutes A pink color indicates alkalinity There are a number of special tests for comparative purposes, and such data as lost water and vulnerability to alkaline fluids are also obtained

Precautions in the Use of Caramel

CARAMEL is formed from sugar during cooking and may contain furfural This material, which is volatile in steam, is slightly toxic—one tenth of a gram causing headache in man and five times that quantity killing a cat Furfural is formed in the greatest amount at about 200° C so that in candy making as low a temperature as possible should be used Since the material is volatile in steam, no precautions are necessary in the preparation of materials like frosting, where the caramel is heated with water It is desirable, however, to boil caramelized fruit syrups, using an equal volume of water for ten or fifteen minutes before serving them, and care should be taken to avoid formation of caramel in baking fruits This work has been done by Plaisance and Monsch at the Iowa State College and Agricultural Experiment Station

Use for Gallium

IN Scientific Paper No 371 of the Bureau of Standards success is reported in devising a cadmium vapor lamp desired for securing a stable monochromatic red light source of high intensity It was desired to use a lamp of the mercury vapor type, but neither pure cadmium nor a cadmium mercury alloy could be used owing to several practical difficulties It has been found, however, that less than one per cent of gallium, which readily alloys with cadmium, so lowers the tensile strength of cadmium as to avoid lamp breakage and the vapor pressure of gallium is so low that its spectrum does not interfere with the brilliancy and purity of the cadmium spectrum The lamps of this type that have been used are equipped with lead seals to avoid leaking about the electrodes and can be operated continuously with high intensity in the cadmium lines of the spectrum

Separating Metal by Centrifuging

IN the *Philosophical Magazine* for March there occurs an interesting account of an attempt to determine whether common lead can be separated into isotopes by centrifuging in the liquid state As is well known there is an isotopic lead somewhat radioactive which differs from ordinary lead in a small degree in both atomic weight and density Common lead is a mixture of these two In the experiment, the lead was maintained liquid by an electric device and the centrifuge was run at a rate of 9,000 revolutions per minute None of the six portions of lead removed showed any difference in density between the top and bottom and there was no evidence that the desired separation had been obtained The authors have proceeded further and attempted to separate silver from lead as a substitute for cupellation, but this also was unsuccessful In alloys of lead and tin, and lead, tin and bismuth there was an appreciable difference between the upper and lower layers of the centrifuged alloy The authors believe if they could employ a centrifuge running with a higher peripheral velocity definite results could be obtained, particularly in separating a definite alloy like the tin lead alloy

A New Source of Alcohol

IN the Bulletin of the Imperial Institute a discussion occurs relative to the possibility of using the mowra flowers of India as a source of alcohol The thick petals of these flowers are rich in sugar and are used by the natives as a food and more particularly for the fermentation of an alcoholic liquor called "daru" or mowra spirit The tree produces 200 to 300 pounds of flowers per year and is cultivated for its valuable oil seed The flowers have been used as a source of acetone, yielding ten times as much as that obtained by distilling wood It is estimated that about 90 gallons of 95 per cent alcohol might be obtained per ton of dried flowers, and in one State in India there are said to be sufficient trees to produce 700,000 gallons of 95 per cent alcohol yearly Already alcohol so produced has been used experimentally as a motor fuel in India

Lignite Briqueting

ARRANGEMENTS have been made by the Bureau of Mines for cooperative work designed to make possible a favorable report which will stimulate the duplication of such a plant as it is intended to construct to demonstrate that lignite may be economically prepared as a fuel capable of storage

The plant is to consist of a series of ovens which it is thought will coke a hundred tons of raw lignite per day In this process the by-products will be recovered and from the carbon residue briquets are to be formed The briqueting plant will be so located that the char will be passed directly from the ovens to the hoppers of the briqueting machines. A part of the money for this demonstration is supplied by the Government and twice that amount by individuals who have been active in an effort to utilize the vast deposits of lignites to be found in different parts of the country

Hemlock Sole Leather

IN the March 25th issue of *American Leather*, the Tanners Council publication, is an interesting discussion on hemlock sole leather—a historical American production—which those interested in the subject will find interesting and informing Among other things, the article indicates the influence which the ease of securing hemlock bark has had upon the location of tanneries in the past, regardless of climatic conditions, nearness of other raw materials, and transportation facilities

Granulite

IN a late issue of the *Chemical and Metallurgical Engineering* a report of the American Chamber of Commerce in London is quoted to the effect that the discovery of a large deposit of granulite in Great Britain will put English glass manufacturers in a position to compete on a favorable basis in the world's neutral markets This mineral contains not only silica, but potash and soda and gives good results in the manufacture of glass ware of the highest quality The difference in cost of the new materials compared with that now in use is 15 shillings for the former and 2 pounds a ton for the latter This mineral is suitable for pressed articles and window glass, glass enameled metal ware, and electrical insulators The waste materials formerly used only for road building will produce dark colored glass

Hard Rubber in Chemical Industry

BECAUSE it is non-corrosive and non-absorbent, hard rubber finds special application in industrial chemistry From it pumps and fittings, pipes and utensils are made with sufficient flexibility and strength to perform the service Through research it has been found possible to so vary the physical properties of hard rubber as to meet satisfactorily peculiar requirements, this being done by changes in the mixing of the batch, hot treatment, and curing methods. The quality of hard rubber depends upon the compounding and vulcanizing as well as the quality of the raw materials Besides resisting acids and numerous other chemicals, hard rubber can be depended upon not to soften until nearly 212° F, but for the sake of safety chemical equipment is rarely used above 160° F. Being a molded material it appears in all sorts of shapes and sizes, including nearly a complete line of pipe fittings The chemical pumps are rated from 6 to 65 gallons per minute capacity

Chemical Industry in France

IN France, as in America, the importance given the chemical industries by the war is being shown by increased productive capacity. In 1913, sulfuric acid, which is one of the foundation stones of the chemical industry, was produced to the extent of 1,224,000 tons and this was 1,000,000 tons in 1919. Nitric acid advanced from 20,000 in 1913 to 360,000 tons, liquid chlorine from 300 tons to 90,000 tons, and calcium carbide from 32,000 to 200,000 tons in 1919

Determination of Alcohol

AT a meeting of the New York section of the American Chemical Society held recently a new device for determining the percentage of alcohol in beverages with a fair degree of accuracy was exhibited The method depends upon an accurate determination of the boiling point or ebullition point, from which the apparatus derives its name, ebulliscope The principle is not a new one, but the apparatus has been simplified for more universal use and as a test can be made in about 15 minutes the device is expected to be very useful since the margin necessary to keep within the law is a narrow one The frequent use of this test enables the manufacturer easily to control his product as it goes through the plant It is possible of course to prepare drinks from grain with less than the alcohol allowed by law, but usually when first prepared these beverages contain two or three per cent This excess is removed by passing the fluid in thin sheets over hot surfaces or by heating the material in a vacuum, with the recovery of the excess alcohol

Research in the Woolen Industry

A RESEARCH committee has recently been established by the National Association of Woolen Manufacturers for the purpose of considering in what particulars scientific research might be applied to the problems of wool manufacture at the present time Having determined a few of the problems which appeared to be most pressing, it is probable that the committee will determine where the work can be undertaken to best advantage, under whose direction it is to be conducted, and prepare a budget for presentation to the Association In Great Britain a research association has been established composed of various wool manufacturers This is one of a series of such associations fostered by the Government Department of Scientific and Industrial Research In the April bulletin of the Association, notation is made of a conference with the Director of the Bureau of Standards as to problems which might be undertaken on behalf of the manufacturers by the Bureau and it is understood that plans are being formulated for carrying on this work

Dyeing and Printing

E. W PIERCE, the author of an article on the development of dyeing and printing in the *Textile World Journal*, states that red, yellow and black were used in ornament and decoration between 2,000 and 5,000 years ago Authentic records date back 2,000 years B. C., when calico printing was practiced in India and it is believed that printing preceded dyeing. The oldest dyeings are those found in the mummy cases of Egypt, running back to 1580 B. C. According to Pliny, madder, purple, safflower, woad, and kermes were used together with iron stains. The mordant was probably applied by means of blocks, stencils or brushes, after which the coloring matter was dyed in According to the Egyptian records, red, brown, maroon, yellow and blue were available. At one time the Chinese produced a smoky gray colored cloth by a laborious process of treating the material with soot and glue and then pounding the fabric on a stone, after which it was washed and the process repeated until the desired shade was secured.

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Coasting down the hills of the Ivory Coast of East Africa

Coasting in Darkest Africa

BOYS are boys the world over No better evidence of this fact could be found than the accompanying photograph, showing how boys on the Ivory Coast of East Africa enjoy coasting down steep hills on home made coasters In this instance a coaster consists of four pieces of wood and four cylinders of hardened clay serving as wheels It is a safe bet, however, that the African lads get just as much enjoyment out of their crude coasters as the American lads do with their ball-bearing vehicles

Turning Over the Eggs

THE stick-to-it iveness of the broody hen is common knowledge rocks and other impediments placed in the nest being little discouragement to her persistence If permitted to sit on the eggs all day, the hatching qualities of the hen fruit may be marred Anyway, eggs for hatching should be collected in freezing weather to avoid chilling

Numerous commercial devices have been designed for keeping eggs when frequent turnovers are prescribed that artificial heat may penetrate all portions of the egg The poultryman shown in this photograph has built a home made device for turning the eggs when large numbers are being saved for hatching The illustration adequately describes the mechanical details of the turning rack, where trays serve the purpose of exposing the eggs to the warmth of the room, otherwise the eggs would require shuffling with the hands The turning rack is a convenient labor-saving equipment for handling the products of the hen in a room where the temperature varies from 50 to 60 degrees Fahrenheit. A more liberal temperature variation is permissible.

Both hen and incubator are impotent to hatch healthy chickens from weak germs, and hence the desirability of proper handling of eggs used for hatching purposes If the collection is stored for only a couple of days a turnover is unnecessary Daily use of the turning rack is recommended by the United States Department of Agriculture if the eggs are to be retained in storage for a week If mechanical ingenuity is totally absent around the poultry yard—an almost improbable environment -then commercial egg cases can answer the purpose of the home-made turning device

A home-made rack for egg-turning operations

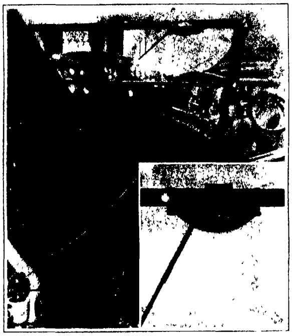
Fitting Arms to the Electric Truck

AN ingenious apron attachment for the ordinary electric truck has eliminated the heretofore heavy labor involved in handling the usual 800 pound rolls of news print paper The truck fitted with the apron attachment picks up the heavy rolls, carries them off and even stands them on end The roll-carrying mechanism consists of a heavy but perfectly balanced steel apron with a chisel member, shaped in such a manner that the roll is swept into the apron, so to speak, and held in place during transit, through the agency of a bar which slips over the heavy roll The apron is attached to a heavy steel casting which revolves on ball bearings, said steel casting in turn being supported by a rocking structural steel frame When the roll of paper is in place, the frame slips back at an angle, lifting the apron and its load about half a foot from the ground To stand the roll on end the apron is revolved

Handling an 800-pound roll of news-print paper with a new type of electric truck

An Automatic Windshield Cleaner

A DEVICE for automatically cleaning windshields of rain, snow, and sleet from a space directly in front of the driver has been perfected by a Cleveland manufacturer The suction of the motor furnishes the power for operating this device The cleaner part of the device is clamped securely to the top of the windshield frame A small flexible rubber tube runs from the cleaner through clamps which are clipped on the side of the windshield on through the dash and connected to either the intake manifold or vacuum tank by means of special fittings A convenient finger control stops and starts as well as regulates the speed of the cleaner



General arrangement of automatic windshield cleaner and (in insert) close-up of cleaner itself

Artificial Pearls from Herring and Shad

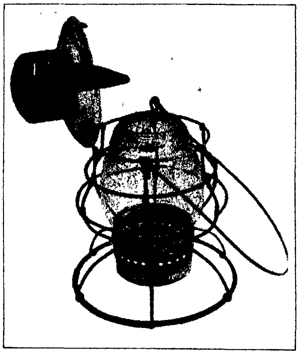
ON account of the war many importations from Paris were cut off, and among them were artificial pearls To make up for this loss many experiments were tried with more or less success The crowning effort was achieved by one of the technologists of the Bureau of Fisheries, who was assigned to the task of finding in the United States a product from which artificial pearls could be manufactured Before the World War French manufacturers of artificial pearls obtained fish scales from Russian fishermen and these were used in giving glass beads the pearl-like luster which converted them into "French pearls The war stopped the Russian fishermen and no longer were French pearls received in the United States American dealers called upon the Bureau of Fisheries to develop a substitute It was found that the scales of sea herring and the shad in Chesapeake Bay possessed the delicate luster similar to Oriental pearls Large quantities of these scales were procured and soon it was found that the silvery coating could be removed by a refining process which separated the coating from the pigment cells, mucous and other materials From this coating 'essence d'Orient" was easily manufactured, which was readily given the name of "pearl essence" by the Bureau of Fisheries This substance contains the peculiar char*acteristic of adhering to any substance*, so the manufacturers found that once the bead was manufactured a coating of pearl essence would harden like cement and give the 'pearl a marked resemblance to the genuine article

How Soot Accumulates in a Signal Lantern

NOT unlike the Scriptural lesson emphasizing the importance of the lamps being trimmed and burning when the bridegroom arrives, the signal lantern of the railway flagman should be in perfect order when the train proceeds on its journey There are several contributory causes to the improper functioning of a lantern and its consequent dim glow but poor signal oil is perhaps the chief offender Hence periodical tests by the United States Bureau of Standards to determine the quality of oil being used in the railway service.

Reams of paper consumed in descriptive text in telling of the tests and their significance would be but a pitiful effort when compared with the glaring example illustrated in this photograph After the lapse of one hour, under the surveillance of a scientist, this lantern showed signs of smoking, with the passing of three hours it was smoking badly and leaving it to burn all night, what was discovered the next morning is told unmistakably by the picture It was not burning when examined, the flame having been largely displaced by an accumulation of soot one and one half inches in diameter and three inches long

The testing of oil used in signal lanterns involves the duplication of the usage to which they are subjected in actual service The lantern is lighted and after the lapse of one hour its candlepower is measured Six hours having passed, the change in candlepower is again noted The reading are supposed to reflect the relative quality of the various oils in use Clearly the fuel being used in the lantern shown in this photograph was of an extremely poor grade



Accumulation of soot in a hand lantern

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Turning the crank of this device marks *the lady's skirt as shown*

Making Milady's Skirt Hang True

TO lessen the time and labor involved in making milady's skirt so that it will hang true, and for all parties concerned, the skirt marker shown in the accompanying illustration was especially designed The mechanism consists of a low platform one inch from the floor, upon which stands the lady The skirt is then placed between the roller and marking wheel carried by an upright arm which is capable of revolving around the platform When the operator revolves the crank at the top of the arm a motion is imparted to the roller and marking wheel below, at the same time the arm is pushed around according to the speed given to the marking wheel thus forming, when so operated, a complete circle or mark around the bottom of the skirt The average time consumed in making such mark is *about forty seconds*

A Wash Pan Reflector

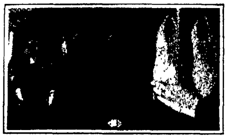
ONE of the best lighted construction camps on the Pacific Coast has harnessed a dish washing pan to serve as its artificial midnight sun The dish pan is used in place of a regulation reflector to throw the beams of electric light to the farthermost recesses of the camp site Permission was had of a power company whose service line passed close to the camping grounds, to plug in on its current for light service. Inventory of the camp equipment developed the fact that no reflector was available Recourse to the dish pan as a satisfactory substitute was made The emergency reflector has served the purpose so well that it has never been changed

A simple wash basin and several porcelain receptacles make an ideal electric lighting unit

Buses May Replace Trolleys

RECENT trolley car strikes have served to demonstrate the efficiency of the motor bus as a common carrier of passengers to such an extent that prediction is freely made that these vehicles may eventually supplant the trolley car During these strikes the motor vehicles used for the transportation of the public have given very good service and it is believed this form of service has now gained a foothold that will be permanent Busses have been operated profitably over lines from which the street car service had to be suspended on account of operating at a loss By filling the breach in the crisis the so-called jitney has won the support of the public and municipal authorities

Street railway officials and even state transportation officials have smugly asserted that the "jitney" could never take the place of the street railway systems Yet, as a matter of fact motor vehicles are very rapidly taking the place of the trolley cars, and will continue to do so with increasing rapidity as the trolley by reason of their financial difficulties are obliged to increase fares and diminish service



Shoes can now be placed in a metal *rack on the back of a closet door*

A Rack to Hang the Shoes

WHEN shoes are left on the closet floor they soon get kicked around and scuffed The metal rack shown in the accompanying illustration fits any closet door and is so made that it will hold any sized shoe securely, notwithstanding the force with which the door may be shut It does not fit the door at a right angle, but tips backward, holding the shoes securely in place

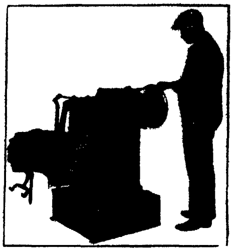
A Machine that Cleans Cement Bags

ONCE more a hand operation is threatened with extinction, due to the introduction of a machine to do the same work This time it is the cleaning of cement bags, which is now being done by machinery

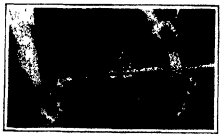
Since there are from six to ten ounces of cement left in each sack after ordinary shaking, it is said that something like $1,000,000 worth of cement is lost each year from this cause alone. Not only is the cement lost that is left in the bags, but freight has to be paid on it in returning the bags to the mill. The story is told of one contractor who saved over 104 tons in building a single industrial plant, by cleaning his bags

By hand, a few hundred bags are a day's work With the machine shown in the accompanying illustration, 150 to 250 bags can be cleaned in an hour, depending upon the operator. And the improvement in working conditions over the disagreeable hand shaking makes it possible to secure more efficient help in addition to the labor saved.

The bag cleaner consists of a counter, exhaust fan, and dust arrester, cover and bag-baling attachment, driven by hand or power No experience is necessary to operate the machine The bag is dropped over the vibrators which are together when the machine is idle A couple of turns of the hand crank and the bag is cleaned, ready to be taken off. The bags are counted and baled, as shown



A few turns of the crank shakes a cement bag clean, ready to be returned to the mill



Tightening the screw shaft applies pressure to remove stubborn machinery parts

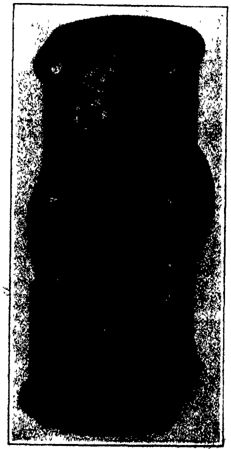
Removing the Stubborn Machinery Parts

A NEW automatic puller facilitates the handling of motor and machinery parts in shop operations, such as textile mills, foundries, mines, garages, machine shops, motor factories, railways and electrical shops, where delicate but heavy parts must be handled carefully and yet where power in handling is necessary The puller is equipped with a set of four arms or hooks, all easily removable so that the puller can be made quickly into a two, three- or four-arm puller A steel screw shaft passes through a center body of conical shape, the arms are fastened to the body in such a manner that when the screw is tightened the screw shaft applies pressure to the part from which another part is being removed, and at the same time forces the jaws to clamp tightly and to pull uniformly with great force The removing of timing parts, magnetos, pump shaft gears and couplings is made relatively easy with such a puller

Regulating the Stroke of the Windmill

THOUGH in late years the gasoline engine has to some extent at least supplemented the windmill on the farm for pumping water, a new invention gives promise of bringing the windmill back into favor, for after all wind power is the cheapest form of power we have at present

The novel feature of this new invention, which has been worked out by A B Sabin of Node, Wyo., is that instead of furling the mill to adjust its power to the load, the load is adjusted to the power of the wind. This is accomplished by automatically varying the length of the stroke, so that the greater the wind pressure the longer the length of the stroke The adjustment is brought about by placing in front of the power wind wheel a small wind wheel which works against a coil spring and turns a small shaft inside of the power shaft This small shaft, by means of a worm gear and a coarse screw, draws the crank pin to or from the center of revolution of the crank arm through a slot in same Because of the worm gear, it is a locked mechanism to all external forces acting upon the crank pin. The construction and design are simple and economical, with all the moving parts enclosed in an oil-tight case, which makes the maintenance practically nil It would seem possible to incorporate this device into almost any direct stroke windmill, with little alteration of the present designs.



Broken-away view of new windmill mechanism for automatically regulating stroke

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to Correspondents are printed from time to time and will be mailed on request. Please write your queries; do not telephone them, please.

(14363) B. R. S. asks: What class of lever is an oar when a person uses it in rowing a boat? Does the person have a mechanical advantage of power or of speed, providing the blade of the oar stays where it is placed in the water? Same information if the oar does not remain where it is placed in the water. I believe that the same principle is used on the ordinary steam locomotive and considering one side, does the power exerted when the driving center of the driving wheels is below the axle give it the same amount of forward power as when the driving center is above the axle. A.—1. The class of lever to which the oar belongs is easily answered if you state what an oar is for, what work does it do The answer is of course it moves a boat The boat then is the weight to be moved, and the hole pin or rowlock is the point of application of the weight. The power is applied by the hand and the handle of the oar is the point of application of the power There is nothing left for the water but to be the fulcrum, and a well manned oar is practically at rest in the water, especially after the boat gets well under way You must realise that the object of an oar is not to pull water around The water cannot be the weight unless the object is to pull water around The oar is a lever of the second class, power weight, fulcrum, weight in the middle The power arm is longer than the weight arm and the mechanical advantage is in weight moved, the weight moved is greater than the power and moves slower than the power 2 If the driving center of a locomotive wheel is below the center of the wheel, the power would act as a lever of the third class, fulcrum on the track, weight at the center of the wheel and power between the two. When the driving center is above the center of the wheel the lever is of the second class. Power weight, fulcrum on the track This is decided by the fact that the object is to move the train, which acts at the center of the drivers If the fulcrum does not hold, the wheel slips. The weight is the same, but the fulcrum gives way, just as an oar may in the water, and the rower may catch a crab, as it is called If the driving center is below the center of the wheel, the gain is in speed, if above, the gain is in power.

(14364) J. R. E. asks. Would you be kind enough to please furnish me, if possible, with the formula for making the tint or liquid with which electric light bulbs are colored. If possible, I would like to know how to prepare the different colors. A.—The dips used for coloring the bulbs of electric lamps are simply thin quick-drying varnishes colored with aniline dyes of the desired hue, red, blue, green or other color A varnish thinned with alcohol would dry quicker than if thinned with turpentine Some of the commercial lacquers on the market can be used, but we cannot, of course, mention the names of the commercial article in these columns.

(14365) C. A. P. asks: In writing deeds or descriptions of lands, in which certain reservations are mentioned, is the quotation, "of which 0.35 of an acre are to be reserved" correct in reference to the verb "are"? I contend that the verb "is" should be used instead of "are." Should not the fraction "0.35" in this connection, whether written 0.35, .35, 35/100, or 35 hundredths, be followed by "is" instead of "are"? A.—Whether "is" or "are" should be used in the case proposed, depends upon the facts of the case. If the .35 of an acre is one lot of that area, and is thought of as a whole, then "is reserved" is the proper verb; but if you have small lots of one-hundredth acre each and 35 of these in your mind then "are reserved" is the proper form to be used. Probably our first statement meets the case since the lot would be too small to be of value. But if the lots were larger a case might be made out where *are* reserved would be used. It does not matter how the fraction is written in deciding the point at issue. It depends solely upon the viewpoint of the writer. If he has in mind a unit of which he has 35 then a plural verb is required, otherwise a singular verb should be used

NEW BOOKS, ETC.

California Highways. By Ben Blow San Francisco: Manager, Good Roads Bureau, California State Automobile Association, 1920. 8vo, 308 pp, illustrated

Neither a technical work nor a tourists' guide, "California Highways" is simply the story of the development of state and county highway systems, told in response to public demand Organization, financing, types of construction, and labor and maintenance are set out in as popular a way as is consistent with accuracy, the larger projects are separately taken up, and campaigns and county activities are historically treated There are 30 good maps and many splendid plates

Strategic Camouflage By Solomon J Solomon, R A New York: E P Dutton and Company, 1920. 4to, 62 pp, illustrated

This is an arresting, one might say unique, work German methods dominate the exposition, and not until the war ended were the magnitude and perfection of these methods recognized To pick one sentence from Ludendorff's "War Memories," "This concentration of 40 or 50 divisions had not been observed by the enemy" How such secret movements were accomplished the text, photographs and colored drawings of this book clearly demonstrate Relative tone values are studied tricks such as sham tram lines on hangar roofs exposed, and we see that camouflage is indeed "an art to be taken seriously," a tremendously important arm of defense still in its infancy

Lettering with Pen and Brush (By Wm. Hugh Gordon. Cincinnati The Signs of the Times Publishing Co., 1920 50 8vo cards

The Gordon System is a departure from the usual bound text book, presenting its lessons on large, separate cards Each card contains two lessons, and the convenience of being able to place a particular lesson upright before the worker, as a copy, will at once appeal to students The familiar music staff is used as an aid to alinement and construction, and card writing and commercial art work are exemplified.

By-paths in Curio Collecting By Arthur Hayden New York Frederick A Stokes Company, 1920 8vo., 462 pp, illustrated

Collecting, an absorbing by path of human activity, has itself by paths that Mr Hayden has charmingly described To preserve the historical and permanently beautiful from oblivion is not an ignoble aim the author rescues for us old fans, playing cards, silhouettes, chests and teapots, and—more sinister souvenirs!—mantraps and spring guns, and ancient woodcuts such as those of the Dance of Death Fine illustrations double the value of the work

Photo-Engraving Primer By Stephen H. Horgan Boston American Photographic Publishing Co., 1920 8vo, 81 pp

Apprentice engravers and others will find in this book an authoritative response to a genuine demand for concise instruction in this subject The studio and its equipment, the darkroom, chemicals, recipes, and approved methods, are so put before the reader that he is enabled to produce creditable work either in line or half tone

Prices and Price Control in Great Britain and the United States During the World War By Simon Litman, New York: Oxford University Press, 1920 8vo.; 381 pp, graphs.

This is No 19 of the Preliminary Economic Studies of the War, edited by Prof David Kinley. The presentation of the subject is thorough, the conclusions point to the fact that for relief from profiteering and manipulation we must look to psychological rather than legal influence Foodstuffs, fuel, metals and textiles are separately and informingly discussed, and our Government's war policy is in the main upheld.

America's Greatest Dam By William Benjamin West, B S Boston: W B West, Massachusetts Institute of Technology, 1920. 8vo., 64 pp; illustrated

This attractive album comprises a fine gallery of photographs of Muscle Shoals, the great dam, and the outstanding features of Nitrate Plant No. 2, with sufficient textual matter to make clear to the technologist and general reader the immensity of the undertaking and the ways in which problems were surmounted.

All About Tank Cars New York and Philadelphia: Standard Tank Car Company, 1919. 8vo, 657 pp, illustrated

In this unique work attention is centered upon a mode of transportation that did yeoman's service during the war and is steadily growing in favor There are specifications and drawings of trucks, tanks and cars for all purposes, and the Code of Rules is given, with a full index The book abounds in useful tables, foremost among them being "Copyrighted Distances," compiled with especial care and not to be found elsewhere, and showing mileage allowance prior to and after the Commission's ruling of October, 1918 This permits ready reckoning of the mileage earned by cars of all the important roads The dependence of our merchant marine on the tank car should alone give this work a prominent place in railroad literature

Cocoa and Chocolate By Arthur W Knapp, B Sc London Chapman and Hall, Ltd., 1920 8vo, 210 pp, illustrated

Cocoa culture is gradually assuming the aspect of a science, and world production has risen from 194 000 tons in 1908 to 431,000 in 1919 The author has given us an accurate, readable account covering the history of the product from plantation to consumer, with recent developments interestingly sketched. Cultivation, harvesting and preparation for market manufacture of cocoa and chocolate by products, composition and food value, all are briefly but adequately dealt with, and both in text and illustrations British manufacturers have coöperated to make the book authentic and comprehensive

Tin, Sheet-Iron and Copper-Plate Worker By Leroy J Blinn New York. Henry Carey Baird and Co, 1920 12 mo, 334 pp, illustrated

An old workshop companion here appears in a new, thoroughly revised edition, with improvements and additions that bring it up to date In pattern cutting, the modern system of triangulation is emphasized Metallic alloys and solders are dealt with very systematically and the best modern practice is incorporated The recipes and tables have been passed upon by experts, and the sheet metal worker may turn its pages in confident expectation of finding much that will benefit him from day to day

Tanks in the Great War 1914-1918 By Brevet-Colonel J F C Fuller, D S O New York E P Dutton and Company, 1920 8vo, 331 pp, plates, diagrams and maps

The brotherhood of the Tank Corps, rallying about their Chief G S O, have helped him to write the inside history of their revolutionary engine of war Colonel Fuller is not only an enthusiast on tanks, he is a keen observer and thinker—and a writer His work is healthily sensational without losing caste as a record of facts He explains how the tank, a descendant of the old war cart of 1456 and of the modern tractor, came into being, its mechanical characteristics, and its employment and achievements in the war It is a book on no account to be missed

T N B and T N T (Trinitrobenzene and Trinitrotoluene) By Captain M Kostevitch, Russian Guards Artillery 8vo, 38 pp; illustrated

This brochure contains the gist of Captain Kostevitch's investigations and conclusions as carried out in a Petrograd laboratory shortly before the war began His laboratory ultration system is the subject of a folding diagram, and the application of his method of vapor pressures to the study of mixed acids is a feature of the work There are other diagrams of molecular percentages, and a series of microphotographic plates show trinitrotoluene as derived from various substances

Shop Practice for Home Mechanics By Raymond Francis Yates New York: The Norman W Henley Publishing Company, 1920 8vo., 320 pp, 309 engravings

At fourteen the author began to "make things", he looked in vain for a book that really helped the amateur to surmount his little difficulties in an inexpensive, easy way Since then he has solved for an army of amateurs their everyday problems of how and why, here his excellent instruction takes the form of a progressive text in mechanics, telling of the use of tools, pattern making, shop practice, and the construction of small machines His ingenious devices and suggestions will gladden the heart of the home worker.

Petroleum Register 1919. New York Oil Trade Journal Inc. 4to, 652 pp

The industry will find this annual directory greatly enlarged, improved, and of increased usefulness It lists the producers, refiners marketers, geologists, and manufacturers and dealers in equipment, of the United States, Canada, and Mexico The statistical section has comprehensive figures on production, consumption and exports, price records, and other data of importance Supplementary pages issued bi monthly, furnish changes and additions of timely value

Personal Identification By Harris Hawthorne Wilder, Ph D and Bert Wentworth Boston: Richard G Badger 8vo, 374 pp, illustrated

A professor of zoology and a former police commissioner have joined forces to bring before the general public an important problem touching civilized life at many points Insurance companies, banks, and business men are seeing the advantages of some mode of personal identification, and all known methods are described in this comprehensive work From the Bertillon system to poroscopy, procedure is made plain, and of course a great deal of science is devoted to finger, palm and sole impressions, and their classification, and friction-ridge identification and its possibilities are set forth Many authorities contribute information and photographs

Success Fundamentals By Orison Swett Marden New York Thomas Y Crowell Company, 1920 8vo, 307 pp, frontispiece

One of our foremost lay-preachers on the text Success comes forward with an unsermonlike sermon on foundation principles He has pregnant words on health and efficiency a chapter on how to find yourself, and others on confidence, the law of opulence, and salesmanship The book radiates the same infective enthusiasm as its forerunners - an enthusiasm that accomplishes, because it never loses touch with the realities

The Nature of Animal Light By E. Newton Harvey, Ph D Philadelphia and London J B Lippincott Company, 1920 8vo, 182 pp, illustrated

Considerable mystery still attaches to bioluminescence Touching but slightly upon its evolutionary phase and the structure and uses of luminous organs, and attempting no decision as to whether or not the phenomenon is due to the vibration of electrons, Prof Harvey confines his investigations chiefly to the physical characteristics of animal light and the chemical processes underlying its production We know that some material is oxydized The book tells what progress has been made toward identifying this material and explaining why light accompanies its oxidation

Practical Electricity By Terrell Croft. New York McGraw-Hill Book Company, 1917 8vo, 646 pp, illustrated

Without resort to the higher mathematics, 'Practical Electricity' gives basic facts and theories and up to date applications, imparting a true working knowledge The work also constitutes a good review text for the university graduate The electron theory is freely used as an aid to exposition, the analogies are drawn from familiar things, and the excellent illustrations are almost self explanatory A comparison of this with other works of similar character cannot but result in a growing sense of its distinction

Casting Tackle and Methods By O W Smith. Cincinnati. Stewart and Kidd Company, 1920 8vo, 257 pp, 14 plates

Lovers of the much loved sport of angling will meet in the author of "Casting Tackle" a kindred mind They will revel in the simple ingenuity of take a parts, lures and tackle boxes, but the volume also strikes a higher note, it leads the reader into pleasant pastures, beside into, and on flowing waters incidentally revealing the fascinating methods that make the happy and successful angler

Electricity Simplified By T O'Conor Sloane New York The Norman W Henley Publishing Company, 1920 12mo, 218 pp, illustrated

For some years this work has lent a strong guiding hand to the beginner the new edition incorporates the numerous important changes in special branches of electricity—wireless communication, X ray practice, and incandescent lighting, for examples, it combines the merits of a brief treatment with as much simplicity and thoroughness as length allows, using mechanical analogies freely, and taking the greatest pains to give the student a solid foundation of essential theory and practice.

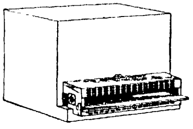
Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of Interest to Farmers

TRACTOR FOR MOTOR PLOWS.—J N Parker, c/o Parker Motor Plow Co Richmond, Va This invention has among its principal objects to improve the operation and reduce the cost of construction of traction mechanism to promote the manual control of the plow and traction mechanism thereof to vary the traction speed and to simplify the *construction of the details* The invention relates more particularly to the construction and arrangement of parts composing the motor plow

BEEHIVE.—D S Rowe Marseilles, Ill The invention relates more particularly to an automatic bee trap The primary object is to provide means whereby the entrance and exit openings of a beehive may be automatically closed by the weight of the occupants to prevent the bees from leaving the hive in large numbers, which is commonly known as swarming' It is a further object to provide a means by which the ordinary passage of the bees in their performance of gathering honey is unobstructed


A PERSPECTIVE VIEW OF A HIVE WITH INVENTION ATTACHED

COTTON PLANTER.—H B Barfield, Fort Necessity La This invention has for its object to provide *a planter of the character* specified by means of which cotton seed may be planted at different depths to insure a fair stand of growing plants regardless of weather conditions which might hinder the sprouting of deep or shallow planted seed

Of General Interest

AWNING AND SCREEN.—F G Darf, 418 Stuyvesant Ave, Brooklyn N Y The invention relates to a combination awning and *screen and has for an object to provide a* construction wherein the full benefit of the screen is secured and at the same time an awning is properly held in position in respect to the screen A further object is to provide a screen and awning formed to be readily collapsible when the screen is to be stored

METHOD OF SURFACING.—J Hamil 509 E 77th St, New York, N Y More particularly the invention relates to surfacing over the conventional scratch' used on ordinary *'stucco'' walls, for this purpose* an ordinary stucco mixture is provided but with any desirable number of vari colored foreign fragments, such as glass, are incorporated in the mixture, which when in a semi plastic state is gone over with the edge of a trowel which serves to turn the fragments to the surface

CULVERT.—M R Dixon, East Peoria Ill This invention has for its object to provide a culvert composed of hollow tiles formed from plastic material capable of hardening and suitably reinforced, the tiles being placed end to end and having means in connection therewith for permanently locking them together *and to the head walls and wherein a con*tinuous compound reinforcement is provided

ROLLING CRUTCH.—M D Scott, 214 N Tremont St, Kewanee, Ill The object of the invention is to provide a device especially adapted for use by invalids who lack confidence in their ability to walk after illness, injury and the like, wherein the crutch is so arranged that it will afford a firm secure support to the user without any possibility of falling and which may be rolled along the ground as the user walks

COMPOUND FOR TEMPERING IRON AND STEEL.—R A Aldrich, Vandalia, Mich The foremost object of the invention is to provide a compound of a few simple ingredients which, when applied to the metal in a cherry red heated state will effectively temper or harden it The compound comprises sal soda 6 parts, sulphur 4 parts, black antimony 1 part and rosin 1 part, all separately pulverized and compounded in the pro*portions stated*

MAYONNAISE MIXER.—J W. Dailey, Box 1361, Walkerseille, Mont The invention relates to beaters for making mayonnaise dressing One of the principal objects is to provide means whereby the olive oil may be fed in the desired quantity, drop by drop, to the dressing while it is being whipped. A further object is to provide a device which is extremely simple, durable, efficient in operation and inexpensive to manufacture

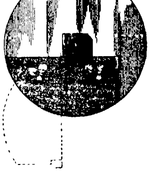
DRIP RECEPTACLE FOR REFRIGERATORS.—C W Fish, 25 Perkins St, Winthrop, Mass It is the purpose of this invention to eliminate the use of the drip pan beneath the refrigerator, or a connecting waste pipe to the sewage system the object being to provide a receptacle which is completely encased within *the refrigerator so that the cooling properties* of the ice dripping are utilized to further cool the food chamber, and to arrange the receptacle conveniently to permit its ready removal *for emptying* without stooping as in the old style pan

HOSE COUPLING.—H J Fitzpatrick 153 Nellie B Ave, Athens, Ga Among the objects of the invention is to provide a coupling which can be quickly operated to couple or uncouple and which when in coupled posi*tion will form a tight juncture of the parts* A further object is to provide a coupling which dispenses with any turning movement of the members relative to each other to couple them together and which is operated by means of a longitudinal movement of the parts

SCREEN FRAME.—M J *and* A Roth, Grand Ave and McIntosh St, East Elmhurst, N Y The invention relates particularly to an adjustable screen frame for windows The principal object is to provide an adjustable structure which is adjustable both in its width and height, with means which render the application of the screen fabric thereto an extremely simple and expeditious task The device provides a strong and durable structure, proof against the entrance of insects

COMBINATIONAL ROOF LADDER AND BRACKET.—H Grush 21 Jacoby St, Johnstown Pa The purpose of this invention is to provide a device which with little or no modification can be used upon the roofs of buildings either as a roof ladder or as a bracket, thus enabling carpenters and other workmen, while at work upon a building, to save time and space

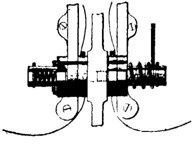
RAT SHIELD.—A G Girard 2825 Laguna St, San Francisco, Cal This invention relates *to rat shields for ship hawsers* the primary object being to provide a cheap and practical device which may be conveniently applied to the hawser in the form of a disk, a section of which is hinged to drop away and admit the hawser to prevent rats from boarding the ship when it is docked at wharves or the like


A SIDE ELEVATION OF THE DEVICE

CALENDAR.—I E Melton, Bismarck, N D An object of the invention is to provide a calendar having a removable calendar pad, each page of the pad having ruled and numbered spaces on the back for writing memoranda the pad having combined rings for holding the pages together, and a brace for stiffening the otherwise flexible pad, a pocket also being provided for temporarily preserving small articles and various data.

DEVICE FOR HOLDING SOFT COLLARS.—F J Antelotti, 136 Granby St, Norfolk, Va *The object of the invention is to provide a de*vice capable of being attached to soft collars or removed therefrom, and of sufficient rigidity to hold the collar erect under all conditions and also one wherein the device may be adjusted to permit use with collars of various heights.

THEATER CHAIR.—O F. Wasmansdorff, Lewistown, Montana This invention has for its object to provide mechanism in connection with the under portion of the chairs to prevent preemption of the end seats, each seat is locked in inoperative position until the master seat is occupied when the adjacent seat is unlocked and so on through the remainder of the row, when the master seats which may be the two center ones are occupied the remainder will be filled toward the entrance aisles, thus preventing the squeezing past those already seated


SHOWING A PORTION OF THE MAIN STANDARD OF A PAIR OF ADJACENT SEATS

LAWN SWING.—G H Bugenhagen, New Jacobson Bldg, Minton N D Among the objects of the invention is to provide a swing which is rigidly supported, and which is provided with seats for one or more occupants, each of which may assist in propelling the swing, the propulsion of the swing being effected by means of the hands and feet The device is simple in construction and not liable to get out of order

CHECK PROTECTOR.—J W Price, 1908 E 6th St Tulsa, Okla This invention has for its special object to provide means for defacing a check or the like in such manner that erasures cannot be made without showing plainly that the check has been tampered with Other objects are to provide in combination with this device a small wrench, a bottle cap remover a screw driver, envelope opener and a spike for lifting corks or for manicuring

BATHTUB.—J N Muskin and R B Crump, address R B Crump, 1110 Broad St, Newark, N J The invention has particular reference *to attachments for bathtubs so designed as to* enable a bathtub to be partitioned off and use not only in the ordinary manner, but also as a combination tub with independent compartments The partition includes a seat structure hinged to the upper edge, this structure being adapted to be used in a reversed position as a basin support

FOOD PRODUCT.—Marie Bloch 377 Richmond Turnpike, Stapleton, Staten Island, N Y An object of this invention is to provide a palatable *and nutritious food product* consisting of tomatoes and eggs mixed together to produce a liquid material, flour added to this and thoroughly worked and kneaded to produce a paste or dough of thin strips, and finally cut into pieces of suitable size to be uniformly dried

WOOD COMPOSITION.—G Magnani, c/o O D Parker, 19 Park Place, New York, N Y The chief object of the invention is to provide a wood composition which will be strong and durable and which will have a highly polished surface, so that it may be especially adapted for use in the manufacture of picture frames or other ornamental devices where a *highly finished surface is desirable* The composition consists of wood pulp, starch, rosin, wheat flour, boiled linseed onl, and water

PASS BOOK AND THE LIKE.—L P Johnson, 523 So 8th St, Salt Lake City, Utah The invention relates to bank pass books and the like and more particularly to blank books in which entries are made from time to time, the object being the provision of page holding and marking means in connection therewith by means of which the proper and *current page for entry* will be indicated and apparent at all times.

ATTACHMENT FOR HOSE.—J. A. Fulton, Astoria, Ore An object of the invention is to *provide an attachment for garden hose which* takes the place of an ordinary nozzle and which permits a spray or stream of any kind to be directed from the hose and which forms a brace for a short length of the hose to permit the ready manipulation thereof.

FOG LIGHT.—R C Grady, c/o U S S *"Florida," c/o Postmaster*, N Y This invention has for its object to provide a light primarily designed for marine use, and when the visibility is low, as for instance during a fog or when the navigational lights cannot be seen, wherein the light is so arranged that a powerful ray may be sent downwardly through the water at a slight angle, to be reflected from the bottom, to cause the rays to be visible at the sides of the ship when the water is shallow

FLY ESCAPE.—C LeR. Cassady, c/o Strand Theater, Marion, Ky. The object of this invention is to provide an escape adapted to be used in connection with screens, for permitting flies to escape at the top of the screen, wherein the escape is formed from sheet metal cut and bent to shape, and capable of being easily attached to the screen frame at the top thereof

CRAP DICE FRAME.—W N Cobb, c/o R Blackinton & Co, North Attleborough, Mass. Among the objects of the invention is to provide a frame adapted to hold a pair of dice together and which is provided with means for attaching the device to a watchchain or the like whereby the dice so held will be displayed A further object is to provide dice with precious stones embedded therein, and, although ornamental in appearance, are thoroughly practical commercially

Hardware and Tools

TOOTH FOR SHOVEL DIPPERS.—C H Mulroney, 7314 Howard Ave, Cleveland, Ohio The invention has for its object to provide a tooth for shovel dippers having a base with a detachable wearing plate at its bottom and a detachable point at the front of the tooth The point has a rearward projection fitting a cavity or recess in the base, and the base has a forward projection fitting a cavity or recess in the point There being an opening in the base so that a bolt may be disposed to secure the foot of the point to the base

SKIN MARKER.—O H Foss, Box 335, Maddock, N D An object of this invention is to provide a portable skin marker which when moved over a skin will operate to cut or sever the skin, and at the same time provide a series of transverse cuts at both edges of the severed portion which may be of a depth and spaced apart a uniform distance so as to identify the goods The device may be easily manipulated and will most efficiently perform the work The same invention has been granted a second patent for skin marking, the object of this being to provide a device for puncturing a skin, and clenching an eyelet marker in the skin, the device can be quickly operated and is strong and durable in use

SHADE ROLLER.—D. E Schimmel, 194 Hooper St, Brooklyn, N Y An object of the invention is to provide a shade roller having a minimum number of parts and arranged to operate smoothly A still further object is to provide a pawl and ratchet mechanism in which means are provided which co act with the spring and roller for positively gripping when the roller is being unwound and *for easily releasing when the spring is re*winding the shade

DIGGER.—W Lambert, Grandview, Wash The invention pertains more particularly to devices of this character especially adapted for digging holes for fence posts, trees, plants, etc The device comprises a pair of blades pivotally carried by a casting, a handle and a sleeve slidably mounted thereon to open the jaws of the digger and dump the dirt therein contained

DOOR LOCK.—I. Hammer, 811 East 165th St, Bronx, N Y, c/o Goldenberg Bros & Co. This invention has reference more particularly to a combined permutation and key operated door lock. The primary object is to provide a lock which may be operated by either a key or a combination so that in the event that the key is not accessible any one

(Continued on page 218)

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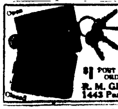

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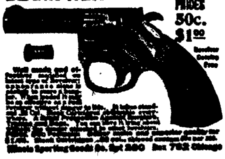

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The Falsework for a Big Dam

(*Continued from page 204*)

face Where the canyon is not especially V-shaped, the span does not change much from level to level The pressure does increase toward the bottom, so that the arch must have greater and greater resistive capacity as one passes from upper to lower levels. In this Warm Springs Dam, the up and downstream faces are essentially parallel from the crest to a level 20 or 25 feet farther down But from this point down, parallelism is lost The dam steadily thickens by the battering of the downstream face This thickening combined with some shortening of the span provides the necessary greater and greater resistive capacity In two of the views, this thickening on the downstream, or concave, side may be noted by observing the bent trestle posts on that side

The trestlework shown in the views is one and the same trestle in all The concrete is, however, at various levels Where the concrete has risen to a level approaching that of the crest, a good deal of the horizontal timbering has been removed and naturally a lot of oblique bracing is also gone The long and vertical posts are still in evidence By using a single trestle structure for the upper half of the dam, the provisions for horizontal transportation along the curved length of the dam were simplified One floor and one set of tracks were all that were required instead of a reconstruction of floor and tracks at various levels as the dam grew The concrete was delivered through bottom dump buckets and these discharged into a flexible metal pipe 8 inches in diameter The mixing plant was set at a high level and discharged into the buckets

Of course, the trestlework was not the form for the faces of the dam Still it supplied supports for the temporary attachment of the form sheets The constant curvature naturally simplified the design of these forms, especially on the upstream face A representative form was 4 feet high and 14 feet long It was set in between trestle posts and secured by dowels penetrating the posts

The posts were secured to the rising concrete by an anchor for each lift of 4 feet That is an anchor would be imbedded in the concrete, and then a bolt through the post would be secured to it The anchors were arranged to be flush with the concrete surface

The dam is 549 feet long, 469 feet of this being curved This is a crest measurement At the base the length is 200 feet The spillway length of the crest is 324 feet When the water is 5 feet deep on the spillway, 12,000 sec-ft are passed over This is probably ample for floods, as the maximum run-off on record is less than one half of this

The length of the dam is divided into five sections by expansion joints These joints are not simple axial planes There is in each on one face a rectangular depression $6\frac{1}{2}$ x 30 inches in cross section, and in the other face a similar projection, the two coacting There is thus a tie between the one face and the next and a provision to cut off seepage The joints are drained by long 4-inch pipes which discharge at the dam's base

The provisions for unwatering to a fairly low level the basin lying back of the dam are of interest The central radius of the dam extends to the north On the west side are the sluice vents The water to reach them must swing southward paralleling the upstream face and pass into two inlets where stop planks are arranged These openings are in a vertical plane at right angles to the face of the dam Entering, it swings around a right-angled curve, two conduits guiding, and then enters the sluiceways proper and passes through the base of the dam at right angles to its faces

(*Continued on page 219*)

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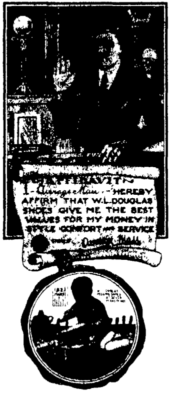
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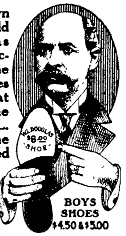

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RECENTLY PATENTED INVENTIONS

(*Continued from page 216*)

knowing the combination may unlock the lock

AUXILIARY LEVER ATTACHMENT FOR JACKS.—S P Barker, 430 W 48th St, Montclair, N J The invention relates to hoisting apparatus and has particular reference to lifting jacks designed especially for being applied beneath the rear axle of an automobile or other place that is ordinarily more or less inaccessible for the positioning and manipulation of a lifting jack by means of the usual short lever, the special lever provided being jointed and foldable into small lengths

BORING TOOL.—L P Crosman, Deering Junction Portland, Me The invention has for its object to provide a boring tool comprising a rotary head and flat spiral bits secured thereto and extending from the end thereof outwardly and rearwardly along the surface of the head, the head being cut away beneath and to the rear of the bits to provide clearance for the chips

TOOL HOLDER.—W S Whyte, Bedford, Ind The invention relates to devices associated with pneumatic-operated tools for holding the latter so that the tool may be operated without transmitting its motion to the handle and hands of the operator, whereby injury and other attendant disadvantages are eliminated It is a purpose of the invention to provide a holder which is extremely simple, but which effectively absorbs all shocks and jars

MARKING APPARATUS.—W C Morgans, Dubuque, Iowa An object of the invention is to provide means for burning identification characters in furs or skins of any character, which cannot be obliterated by the ordinary tanning process The apparatus comprises a stencil adapted to be located against the skin, and an electric hot point adapted to pass through the perforations

CLAMP.—C Drake, Mannington, W Va An object of the invention is to provide a clamp which can be conveniently secured around a post A further object is to provide a clamp which is especially adapted for use in metal frame structures, and is adapted to clamp posts or standards of tubular or cylindrical form and provide a secure and convenient means for connecting the braces and girders to the post

LOCK FOR MAIL BOXES.—R B Lillard, 2822 Boulevard, Jersey City, N J This invention has for its object to provide a lock especially adapted for use with a series of mail boxes, for instance, the boxes of apartment houses, for permitting the simultaneous release of the doors of all the boxes, or to lock the boxes, without interfering with the locks pertaining to the individual mail boxes.

COMBINATION TOOL.—S P Holish, 2101 Marshall Blvd, Chicago, Ill Among the objects of the invention is to provide a tool which combines a plurality of tools ordinarily provided as separate implements, performing the different operations ordinarily performed by the tools with equal effectiveness and a great saving of time The device consists of a saw blade, whereby a combination tool is formed comprising a handsaw, a square, a ruler or scale, and a bevel

Heating and Lighting

STOVE AND FIREPLACE.—O V Bumpass, Corinth, Miss This invention has for its object the provision of a device of the character stated especially adapted to be arranged in a fireplace opening and possessing when so arranged the capability and utilities of both a stove and a fireplace A further object is to provide a device which is simple and of durable construction, and inexpensive to manufacture

COMBINED GRATE AND ASH SIFTER.—J A Long, 506 Norwood St, East Orange, N J Among the objects of the invention is to provide a construction including a sifter for ashes located in the ash pit beneath the grate and means to cause the sifter of the ashes simultaneously with the shaking of the grate, and the delivery of the clinkers or unburned lumps of fuel forward of the ash pit whence they may be scooped up to be reburned or otherwise disposed of

FURNACE.—L J Clossey, 587 Fairview Ave, Detroit, Mich This invention more particularly relates to hot air furnaces an object being to provide a furnace composed of sections secured together and forming an arrangement of air passages and smoke passages whereby the maximum of highly heated radiating surface is utilized A further object is to provide a free draft without danger of soot or ash accumulating to interfere with the draft or radiation of the heat.

Machines and Mechanical Devices

SPINDLE OILER.—M P. Williams, Gilbertville, Mass. An object of the invention is to provide means for oiling a series of spindles, which results in rapidly and uniformly applying the lubricant to the spindles without wastage and without soiling the parts of the machine or the floor, a brush applying the proper quantity of lubricant to each spindle as the device moves along.

FOOD DELIVERING AND ORDERING APPARATUS.—W F McGlaughlin, 470 So Grant St, Denver, Colo The invention relates to apparatus for automatically delivering trays of food to diners in restaurants, the apparatus being utilized to return the empty dishes to the kitchen of the restaurant A further purpose is to provide an apparatus for ordering the dishes and for delivering the order to the kitchen, thus eliminating the intermediaries necessary for the transmission of orders from the diners to the chef

SAND STRAINER.—O R. Kirschke, 1116 W 3rd St Grand Island, Neb This invention has for its object to provide mechanism for use in connection with well casings for thoroughly removing sand from the water before it enters the body of the well casing, the strainer having a sand chamber between the bore and the exterior for receiving the sand, together with means for causing the sand to settle

PISTON.—A Nekvas, P O Box 345, Massillon Ohio The invention relates particularly to that class of piston in which the packing bushing is removable from the inner or working side of the piston head The piston comprises a body having a reduced portion on its working side, a cup shaped bushing completely covering the same, a packing ring on the bushing, a ring removably secured to the bushing for retaining the packing ring and a key for locking said ring in position.

HYDRAULIC CONCENTRATING APPARATUS.—W F Sudlow, Lincolnton, N C An object of the invention is to provide means for forcing the ore in a stream of water upwardly in an inclined pipe and to provide an arrangement of boxes in communication with the pipe for receiving the ore A further object is to provide an apparatus which is particularly adapted for use in the recovery of tin ore, but is also adapted to any ore with greater specific gravity than the gangue.

SHUTTLE THROWING MECHANISM.—N Pepin, 172 Lincoln St, Woonsocket, R I This invention relates to looms and its object is to provide a shuttle throwing mechanism arranged to impart a powerful movement to the shuttle to move the same through the open shed without danger of striking therein Another object is to permit of readily applying the shuttle to power looms as now constructed

RECORDING DEVICE.—W D Pearson, 734 East Main St, Portland, Ore The principal object of the invention is to produce a recording device which may be used in recording the hours or periods of operation of a machine, such for instance as a flying machine, with which the device is associated A further object is to produce a device which will be automatic and will start recording as soon as the device to which it is attached commences to operate and will cease when the device ceases operation

Medical Devices

DENTAL ENGINE HANDPIECE.—R C Craig, Abingdon, Va A purpose of the invention is the provision of a handpiece of simple durable and efficient construction, including a clamp for effectively securing the tool so as to prevent its accidental displacement and to securely lock the same to the engine shaft for positive rotation A further object is to provide a handpiece having means for adjusting the tool clamp while the tool is rotated

Musical Devices

SECURING MEANS FOR THE ENDS OF STRINGS FOR INSTRUMENTS.—O J Muller, 500 E 76th St, New York, N Y The invention relates to an anchor for the end of a string adapted to be used in connection with musical instruments, and particularly the E" string for a violin The device provides a simple form of anchoring means adapted to be applied to the key with the loss of only an instant of time The device is equally applicable to any of the strings of a violin, or the strings of any musical instrument or a harp

SOUND RECORDING AND SOUND REPRODUCING MACHINE.—J H Nehrs, 61-79 Hall St, Princeton, N. J. The principal object of this invention is to provide means for the recording and reproducing of lengthy speech or music on a plurality of records, whereby the continuous recording or reproduction can be readily obtained without noticing the transition from one record to another. The operator being given ample time to place the new record in position, prior to the stylus, in engagement with the active record, reaching the end of the sound groove

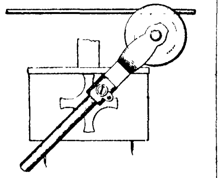
Prime Movers and Their Accessories

SPARK PLUG.—E P Nicholson, 371 Quincy St, Brooklyn, N Y A purpose of the invention is to provide a double electrode spark plug which will simultaneously produce twin sparks to facilitate combustion in the gas engine cylinder. It is also a purpose to provide a double sparking plug so as to make it unnecessary to employ two separate spark plugs in airplane engines, high speed automobile racing motors, and large stationary working engines.

Railways and Their Accessories

COMBINED SIGNAL AND EMERGENCY TRAIN STOPPING DEVICE.—J W Hubbard, 447 Grand Ave West Eau Claire, Wis This invention has reference more particularly to a signal which may be set up on a railroad track a short distance behind, or in the case of a single track system, also in front of the train which is standing still, to warn the engineer of a train approaching against proceeding farther, also in lieu of the signal being disregarded, to provide means as an emergency to prevent a collision by derailing the approaching train

RAILROAD SIGNAL.—W H Harrell, 210 N Peak St, Dallas, Texas The invention relates particularly to automatic signals for displaying a warning at grade crossings An object is to produce a signal for use on electric and steam railway lines to warn pedestrians and vehicles of the approach of the car or train The signaling system operates a semaphone, rings a bell, or illuminates a light, an electric circuit being actuated during the passing car or train

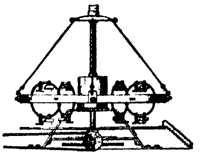


SHOWING A SWITCH HOUSING WITH ELECTRIC TROLLEY PASSING

RAILWAY SIGNAL FLAG.—W. A Johnson, 202 Quincy St, Fairmont, W Va. The object of this invention is to provide an arrangement by which flags of different colors may be carried, each of which is normally rolled upon a conventional curtain roller and may be readily inserted in cylindrical flat containers so that each flag may be drawn out through a slot in the container wall, independent of the other, and the tension adjusted as desired.

Pertaining to Recreation

AMUSEMENT APPARATUS.—P. D. Haunson, Breckenridge, Mont This invention has for its object to provide apparatus of the character specified of comparatively simple construction and consisting of a series of pairs of wings mounted to revolve about a common vertical axis, and to rotate each upon a horizontal axis, with the members of the pairs so arranged that the spheres described by the rotation of the rings will intersect.



A SIDE VIEW OF THE APPARATUS

Pertaining to Vehicles

RESILIENT DRIVE MEANS.—C. Brammer, 106 Bank St., New York, N. Y. The general object of the invention is to provide means to connect a drive element with a driven element as for example a drive shaft with a driven shaft, the invention being more particularly intended to have special advantage when interposed in the transmission means of a motor driven vehicle.

VEHICLE ALARM.—D. A Gillen, 115 N. 15th St., Flushing, L. I, N Y Among the objects of the invention is to provide an attachment for vehicle wheels which is in the nature of a large gong which, when carried by the rotating wheel, will be brought with such impact against the roadway as to cause a clanging noise sufficient to inform the public or officers that the vehicle so moved is being stolen.

VEHICLE WHEEL LOCK.—L. M. Eckert, 414 Clinton St., c/o F M. Risley, Elizabeth, N. J The object of the invention is to provide a wheel lock more especially designed for use on the wheels of automobiles, auto trucks and other vehicles, and arranged to enable the person in charge to readily lock the wheel to the axle to prevent rotation of the wheel and safeguard the vehicle A further object is to provide a lock which can be readily applied to wheels as now generally in use.

LOCKING DEVICE FOR TRANSMISSIONS.—A. E Stenberg, Reed City, Mich. The invention relates to means for controlling transmission and comprises a rod and a sleeve mounted to slide with respect to each other, the sleeve being cut away at one side to the level of the rod and the rod and sleeve having transverse notches at the cut away side adapted to register, and a bolt mounted to slide toward and from the rod and sleeve to lock the rod and sleeve, a spring normally pressing the bolt in engaging position

HEATING FOR AUTOMOBILES.—G S. King, address John Tuomey, 157 E 72nd St, Bay Shore, N. Y. The object of the invention is to provide a heater for automobiles and other power-driven vehicles located within the hood adjacent the internal-combustion engine to heat the latter with a view to prevent the water of the cooling system from freezing and keeping the heater ready for starting the motor whenever it is desired to do so.

IDENTIFICATION MEANS FOR AUTOMOBILES.—J Billings, Park Row Bldg, Room 623, New York, N. Y. To enable a stolen automobile to be quickly identified even among a large number of the same make, this invention utilizes one of a group of bolts or other parts of which several are alike, and distinguishes the selected part by a secret mark or a concealed card Thus, the identifying part of the machine is massed by its resemblance to other similar parts, and this feature also requires that all removable parts be removed for the theft to be safely accomplished.

RIM.—C. M McKendree, Lakeview, Ore. An object of the invention is to provide a rim of circular form, having its ends slightly placed apart to allow for expansion and contraction of the rim, said rim adapted to be contracted by the inflation of the tire, the pressure of air in the tire causing a contraction of the rim A further object is to provide a rim which can be conveniently connected to or disconnected from the wheel.

LOCK FOR MOTOR VEHICLES.—M. Farah, 408 San Francisco St, El Paso, Texas. This invention has for its object to provide a device of the character specified, suitable for use with motor vehicles of any character, for simultaneously locking the gear shift lever from movement and for breaking the ignition circuit

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The Falsework for a Big Dam

(*Continued from page 217*)

at this point There are two sets of gates One pair is in practically the same plane as the upstream face, the second pair is set underneath the upstream toe—that is, a little downstream from the first set The control rods for the first set reach down the vertical convex face, while those for the second set are provided with wells, of horse-shoe horizontal section, which extend up to the crest. Both sets of sluice gates may be operated from the top of the dam In case a vacuum forms because of the flow of the water, at any time, a vibrating action of the gates may take place In order to prevent the formation of a vacuum in the sluiceway between the downstream gate and the downstream face of the dam, a duct is arranged which leads from the ceiling of the sluiceway up a short distance and then horizontally to the dam's downstream face

Making Electric Insulators of Porcelain

(*Continued from page 205*)

Milady is very proud of the glossy appearance of the dinner set on her dining table But the glaze that gives it a glossy sheen is not there merely for looks The cups would not hold coffee or tea, and the plates would be soaked with grease were it not for the glazing that renders the more or less porous porcelain impervious to moisture

And that is exactly the reason why porcelain insulators are glazed While moisture might not penetrate them extensively, it would cling on the minute rough edges of an unglazed surface and tend to create a film of water which would impair their insulating properties

The glazing consists of the same material as the porcelain with the addition of calcium carbonate or whiting, which cause the glaze to melt at a lower temperature than the porcelain. It is applied, in the form of a thick liquid, in several ways Small articles are coated by means of an automatic sprayer which resembles a huge atomizer and sprays the glaze over them Others are sprayed by hand, and still others are dipped into the glazing fluid

After glazing the porcelain is placed in receptacles made of fire-clay resembling the casserole familiar to the housewife, and these are piled in great columns inside the kilns—huge structures of brick about fifteen feet in diameter and sixteen feet high, beneath which is a furnace When the kiln is full, the door is walled up with brick and fire clay, and the fire started.

Three cones, called pyrometric cones, are made from the same materials as the porcelain. The proportions are so changed, however, that the tip of one of these cones will bend over at 20 degrees Centigrade less than the melting point of the porcelain, while the third requires 20 degrees more to melt it than the porcelain These cones can be seen through a small apperture in the kiln The melting of the first warns that the heat is approaching the desired degree. When the second one melts, the fire is carefully manipulated so that the heat will not rise to a degree that would melt the third.

The intense heat, upward of 1,360 degrees Centigrade, melts the glaze, which runs evenly over the outside surface of the porcelain, and vitrifies the latter, making it a hard, dense, impervious mass

After the porcelain has been baked for the requisite length of time and the contents of the kiln have cooled sufficiently, the articles are removed and tested Not only must the insulators meet specifications as to size—and that, as indicated, takes very careful work—but they must be tested for their insulating strength The larger insulators are subjected to tests at from 60,000 to 300,000 volts.

The testing is one of the most interesting phases of the work The spectator sees a row of insulators to which wires are attached The operator throws on the current Down one of the insulators goes a spitting blue line of "fire" with a crackling noise The visitor's face tingles from the electricity in the atmosphere, and there is a pronounced odor of ozone from the oxygen liberated in the air

A Measure of Interior Lighting

(*Continued from page 205*)

involved the making of test objects, such as neutral gray specimens by mixing black drawing ink and lamp black with a white cement After being surfaced with coarse sandpaper, resulting in good diffusers, the surfaces were tested for light-reflecting factors by the observation of surface brightness at intervals of 10 degrees A block of magnesium, a polished sheet of milk glass and white painted cardboard were supplement to the test specimens above-mentioned The high reflection factor obtained for magnesium carbonate was the outstanding result of the experiments

Who Shall Work the Farms?—II

(*Continued from page 208*)

Maine, which normally produces 60 per cent of the potato crops in New England, experienced setbacks in unfavorable weather, strikes labor shortages and transportation embargoes which impeded the normal activities

California planted 60 per cent of normal acreage of all varieties of beans limas being 90 per cent and other varieties 45 per cent of 1919 New York planted 90 per cent as many beans as last year, Michigan, 75, Wisconsin, 70, Colorado, 65, New Mexico, 80, and Idaho, 100. This sort of thing cannot continue without serious results

Not only is farm labor scarcer than usual but it is more independent and less efficient, according to reports of farmers from all sections of the country Those who are attracted to towns, cities and public works get more pay and work fewer hours than they did when on farms while those who remain on the farms are also demanding shorter hours There is a wide complaint among farmers generally of the eight hour-day movement which promises to be the elusive bugaboo of the future

Typical reports from farmers are aptly illustrated by the following A Wisconsin farmer says, 'Decreased acreages, decreased yields and high prices for foodstuffs are sure to result due to the farm help movement cityward I cannot get help I am 60 years old and have only two boys to assist me in handling a 300 acre farm Unless conditions right themselves I shall finally be forced to let my farm run to weeds"

A Minnesota farmer remarks, "I have hired help for 35 years and this is the first season when I was unable to secure any assistance in operating my farm I am forced to seed the place down to grass" From Virginia, a farmer wrote that his community was practically without labor Farms that usually hire three men were using only one and these work only eight hours a day His neighbor, a Tennesseean, says, "If the farm labor situation continues as now for two or three years longer, a man who does not own a farm will be denied even drinking water If factories and mills do not cut down their wages, hard times are sure to come to all"

A New York farmer who handles 300 acres has only one man where he usually uses three. He says he cannot afford to pay a minimum wage of $4 to $5 a day when crops sell at present prices as the production costs more than absorb all the income. The sentiment of a number of Connecticut farmers is that they will not produce 50 per cent of what they raised last year. They cannot compete with the

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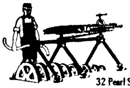

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industries for labor on the basis of present prices for farm products. Oregon farmers are doing what they can with family labor and are letting the rest of their work go undone They refuse to pay industrial rates for farm work. Kansas farmers are trying to readjust their cropping calendars so as to do without high priced help A New York farmer says that in his locality wages are 20 per cent higher than last year while the farm help is 50 per cent short Complaint from the Southern States is that negro labor does only two thirds the amount of work performed three years ago at one-third the present pay

Ohio reports a ten per cent decrease in farm labor over last year and a correspondingly curtailed acreage Indiana farmers say that demand for labor has declined because of high wages. Farmers have cut down their operations so that family labor can handle them Alabama has only 70 per cent of normal labor supply while Mississippi has only three men available to do the work which requires four men Arkansas reports a labor deficit of 15 per cent, North Dakota has only four-fifths as much labor as her farmers need Oklahoma has a labor supply which is only 60 per cent of normal

Practical and Inexpensive Farm Buildings from Willow Saplings

(*Continued from page 209*)

the Far East, or whether spurred on by the mother of invention, necessity, is still a mystery to some At any rate, and in the short time of two days, according to the son who helped him, the barn was finished The willows cut along the banks of a nearby stream were stripped of their twigs and leaves, and carted to the site of the building Here the outline of the barn was marked on the ground, and posts set into the ground on this line, spaced four feet apart The saplings were then woven about these uprights with the result shown in the accompanying photo of the barn This single wall would offer protection to a certain extent from the weather but it would not be sufficient to withstand the winter blasts which would soon be upon them So a second wall was erected about the first, in the same way, and the space between them kept to six or eight inches Later this was packed with straw The roof, of straw laid on saplings, which in turn were supported by poles running the length of the barn, on the top of the walls, furnished ample covering, though wire was woven in and out through the straw and the poles to keep it in place

And so with the rest of the buildings The poultry house has a plank roof, laid over the straw-covered rafters to keep the loose material in place The corn crib has but the single wall, which is sufficient

Another surprising feature about this unique farmstead was the many rods of fencing built of the same material, willow saplings Almost a mile, all told, totals the combined length of the several fences

The Four-Wheel Brake Again

(*Continued from page 209*)

The proper equalization of two brakes is a thing that is rarely accomplished satisfactorily and of course the equalization of four brakes presents still greater difficulty Here again the hydraulic method has advantages. It should be evident that perfect equalization is secured, that is, the same force is applied to all four brakes since the pressure of the oil throughout the system is everywhere the same Therefore the forces acting on the four brake pistons are equal and the brakes are applied with the same intensity

Aside from these advantages the hydraulic system appears to be simpler and less likely to get out of order. The moving parts are limited to pistons and cylinders The oil leads connecting the master cylinder with the brake cylinders are rugged, flexible metal tubes, and it should be recalled that great strides have been made in the construction of metal hose in the past three or four years; in fact it would not be surprising if this were the real reason for the advent of this system at this particular time It is said that leakage is quite impossible.

Inasmuch as brake rods arms, pins and bushings are entirely absent, metal tubing taking their place, one annoying source of rattle is eliminated Brake linkage rattles are impossible where there is no brake linkage.

A Ditch-Digging Giant

(*Continued from page 209*)

Between the buckets with semicircular cutting edges, side cutters are bolted to the wheel for hewing the ditch slightly wider than the buckets, thereby reducing the friction The front end of the frame conveying the excavating wheel is hooked up to the rear of the platform carrying the power equipment. The rear of the frame is supported on a shoe that glides along on the bottom of the ditch, forming a smooth, shallow groove for the drainage tile The maximum depth of digging is two thirds the diameter of the wheel Solid buckets are used for sandy soils, while skeleton containers, easily cleaned, are applied in sticky ground.

The machine is equipped, when desirable, with a cased shoe or shield to hold in abeyance the banks when operating in soil subject to caving The cutting speed of this type of tile-trenching machinery ranges from 1 to 8 feet a minute The varying sizes of this apparatus have capacities for digging trenches ranging from 11½ inches wide by 4½ feet deep to 18 inches wide by 6½ feet deep. Its capacity for overcoming obstacles is suggested by its past performances of slicing off tree roots as large as a man's arm Then, too unless they are buried deeply in the soil stones larger than the buckets are rolled away

Solving the Labor Problem—IV

(*Continued from page 210*)

cuit of some of the best "movie" attractions Here also lectures are delivered by well-known specialists in various fields of knowledge and travel Another appreciated institution is the Marysville Club, which bears the significant name of "The Half Shell," as being synonymous with transparent square dealing, the inference being that an unworthy oyster is quickly determined on the half shell This organization meets once a week, and its platform is occupied by well-known speakers of the country, men who are big successes in every line of business and professional activity The matter of providing outdoor recreation, recognized everywhere today as one of the most important elements in promoting good fellowship in an industrial organization, is greatly favored by the fact that Marysville fronts upon the St Claire River. Already bathing beaches have been formed and there is accommodation at the piers for yachts and small boats so that the employee can take his choice between recreation on land or water.

Thus far in its existence, Marysville has fully justified the expectation of its founders, and as its present population of 2,000 grows with the growth of the parent plant and the several associated industries which have located here, the success of this venture as a solution of the labor problem will be followed widely and with the keenest interest.

Bridges and Civilization

(*Continued from page 211*)

crossing them. Such original bridges were discovered without difficulty. Man had only to follow the example of the animals in flight which chose such means of escape. In the case of the swinging vine, however, the problem is twofold, since the savage was called on to decide whether to cross it by means of his feet or by means of his hands. Having decided to cross on his feet, a second vine sooner or later came into play as a natural railing or balustrade by which to support himself. Then followed the development of the wooden bridge, which type has persisted even to the present day.

It appears that the first iron bridges were erected at Colebrookdale from 1778 to 1779. The first German iron bridge was not built until 1794. Technologically speaking, the wooden bridge falls into three classes; Bridges of solid beams and girders, trestle bridges, and suspension bridges. The MONTHLY proceeds to show how these various classes were developed in many different parts of the world

An interesting case is the bamboo bridge at Rantepoo, on the island of Celebes It is believed that in this bridge we actually have the forerunner of our modern steel and iron cantilever bridges. As for suspension bridges of a primitive type, we find many such structures in the interior of western Africa and in New Guinea and elsewhere. An excellent example of bridge building is the arched beam bridge at Osaka, Japan. Architecturally speaking, it belongs to the girder bridge class, even though constructed of wood, with the members held together by an extremely ingenious system of ties and wedges in which presumably nails and screws are as absent as in the original Malay bridges verifying the fact that the Japanese have an infiltration of Malay blood

Stray Current Electrolysis

DUE to the fact that return current was not formerly given the requisite attention to prevent it from straying from its fixed and narrow path, electric railway companies experienced considerable trouble with vagrant electricity of this description which had a predilection for wandering through the earth until it came in contact with underground pipes carrying the munipical water and sewage supplies or the telephone or telegraph wires. The stray current would run along these pipes for some distance and finally would jump back to the street car rails—which in the single, overhead trolley system carried the current back to the power house An electro-chemical condition would develop at each point where the electric current would leave the pipes which gradually would cause minute disintegration and potentially the destruction of the pipes.

Some thirty years ago this phenomena first attracted public attention and it was some time before it was definitely ascertained that defective rail systems which did not properly confine and restrict the movements of the electric current which passed over them were fundamentally responsible for the difficulties. Heretofore, the bonded rail joint has been the weakest link in the return circuit and until the popularization and general adoption of the welded joint, the use of heavier rails, better bonds, and supplementary feeders, enormous damage to municipal pipe systems resulted in all parts of the country. Even today with conditions much improved and street car companies exerting every effort to control stray currents, the annual damages still are enormous.

The Federal Bureau of Standards has been aiding different cities all over the country in locating refractory pipe lines which have unknowingly become carriers of stray electric current. The work is of inestimable value to the cities in question as with the expert assistance of Uncle Sam's engineers the vagaries of the current are controlled. The demands for assistance of this character are usually far in excess of the force of experts available for such activities.

IN THIS ISSUE:

REORGANIZING THE PORT OF NEW YORK

MAKING A FOREST TO ORDER

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SPEEDING UP FRANCE'S CANAL TRAFFIC WITH THE ELECTRIC MULE.—[See page 229]

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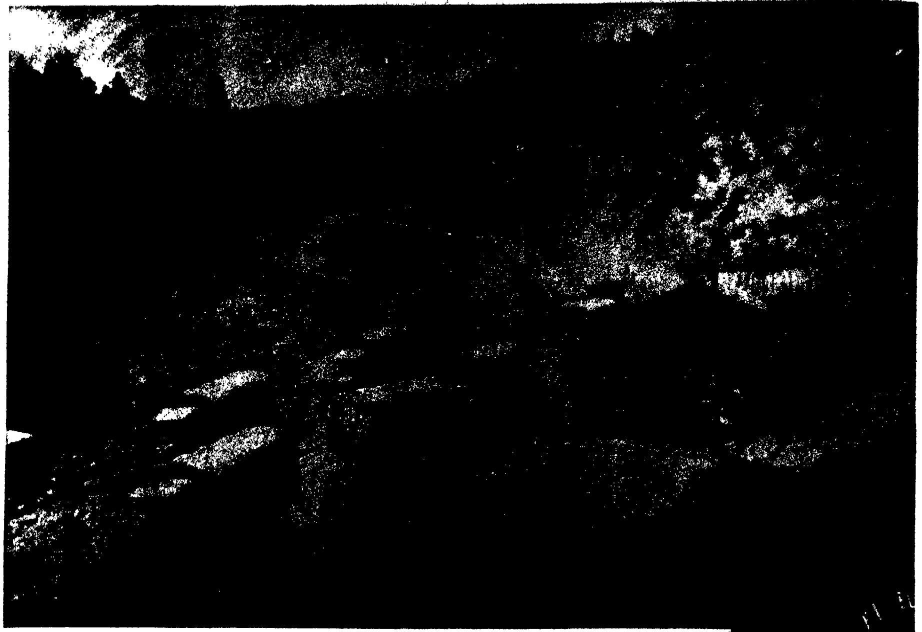

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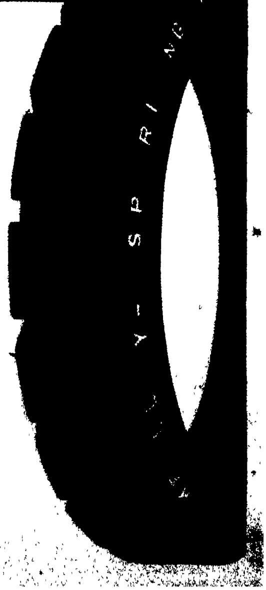

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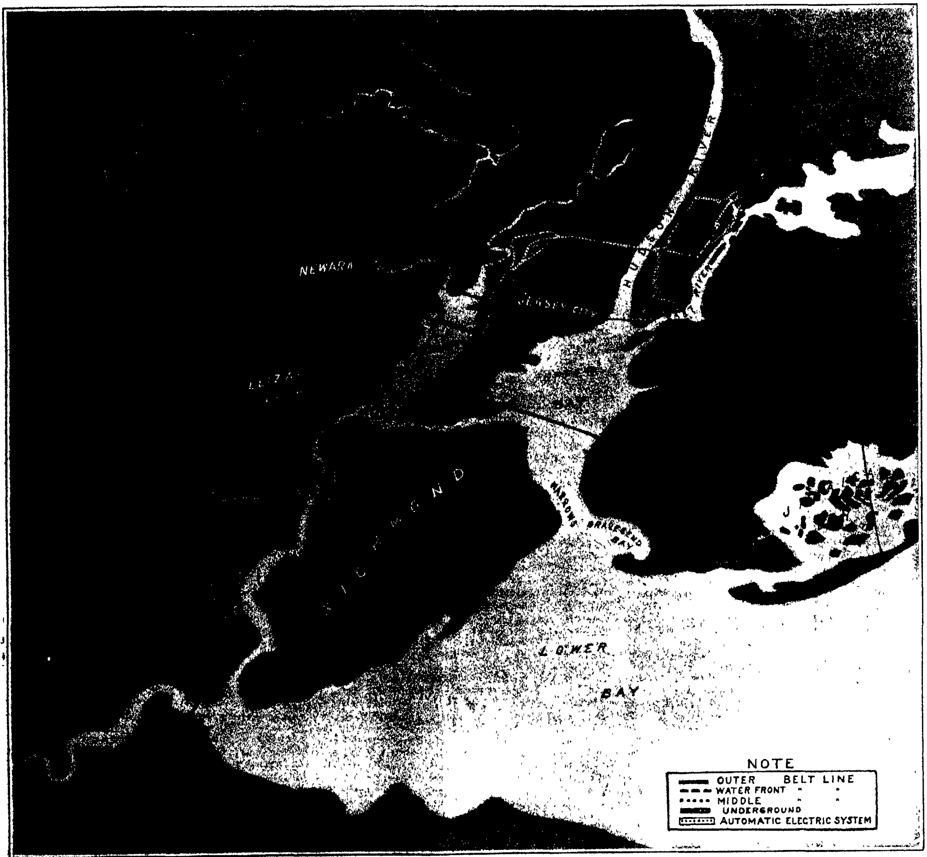

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BIRD'S-EYE VIEW OF THE PORT OF NEW YORK, SHOWING BELT LINES AND MERCHANDISE TUNNEL RECOMMENDED BY THE JOINT PORT COMMISSION—[See page 224]

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Hudson River Bridge or Tunnel—Which?

THE report of the New York-New Jersey Port and Harbor Development Commission, whose plans are illustrated and described elsewhere in this issue, would have been a masterly document were it not for one very serious defect. Its plans for coordinating all the railroad and dock facilities of the port by means of a system of belt railroads are comprehensive and in agreement with the best judgment of the railroad, shipping and port authorities of the day. But when it comes to the question of how best to overcome the great natural obstacle presented by the North River—the one absolute fundamental in the whole question—the Commission seems to have lost its breadth of vision, and fallen into the popular error of believing that, as a great thoroughfare for traffic, a tunnel can compete with a bridge.

Not only does the Commission recommend a tunnel, with its limited capacity, but it bespeaks the operation of this tunnel by an entirely new system of automatic, crewless trains, which has never been tried out on a large scale, and therefore will be experimental in character. Furthermore, this proposed system is to be utilized for a limited portion only of the freight that comes to New York, namely, that of food and general merchandise.

That the system is ingenious, and that it would probably do all that is claimed for it we do not deny, but what we do claim is that food and general merchandise form, at best, only a limited part of the total freight that has to be handled at this port. The tunnel *is not designed to handle bulk freight.* It makes no provision for coal, or wheat, or heavy machinery, and, most serious omission of all, it is not designed to transport a single passenger, either long distance or suburban, *nor will it serve for the passage of a single* automobile or motor truck across the North River.

In short, the report, which starts out with a wide survey of the problem and an apparent grasp of the *multifarious and many-sided character of the traffic* situation, leads the expectant citizen into one corner of the problem and there leaves him. The resident of Manhattan is told that he may have a quicker and *cheaper delivery of his food, shoes and clothes, if he* will foot a bill of $201,190,000, which is what a food-and-clothes carrying tunnel *for lower Manhattan only* will cost. An enlarged tunnel system, to serve all *Manhattan, would probably cost $400,000,000.*

And how about a bridge as a solution of this same food and clothes problem? What would it cost and how much could it carry? The cost, including a classification yard in *the Jersey meadows, a system of truck* delivery from railroad cars in Jersey direct to store door in Manhattan and a marginal elevated standard-gage railway down the west side would be the same, $200,000,000. The capacity for freight by motor truck alone would be over 200,000 tons per day, as against the maximum of 50,000 tons per day claimed by the Commission for the tunnel. For it must be remembered that, as *against the two tracks in the tunnel, we have* on the 140 foot upper-deck roadway of the bridge room for 14 ten foot separate vehicle tracks for motor trucks. It is evident then, that in its own restricted field of food and general merchandise *traffic, the tunnel is out*matched four to one by the bridge.

But carrying general merchandise will form but a part, and a relatively small part, of the service rendered. Because of *its vast size the bridge will have* four tracks on its upper deck and eight standard railroad tracks on its lower deck, besides two tracks for a traveling platform. Let us consider, then, what this means in the way of service additional to that which can be rendered by the tunnel.

In the first place, a carload of freight can be shipped from New Orleans, St. Louis or Chicago direct to the ship's side at a Manhattan, Bronx or Brooklyn dock without any handling except from car to ship. In the second place, through express trains, no matter over what line they arrive, can be run across the bridge to a Union station in Manhattan. A third advantage is that suburban passengers will be carried from Jersey towns direct to Manhattan. Similar through service will be available by the trolley car systems. Lastly, the bridge will afford a continuous highway for the vast automobile and motor truck traffic to and from Long Island, the Bronx, Manhattan and New Jersey.

There can be no choice between a bridge and a tunnel. The above considerations prove to a demonstration that for the some outlay of $200,000,000 the service rendered respectively by a North River bridge and a North River tunnel will be on the ratio of—well—something like ten to one.

Our Merchant Fleet and Free Ports

THE possession of a great fleet of ships does not in itself constitute a successful merchant marine. Unless these vessels are so wisely routed and operated that they are fairly well filled on both the outward and return trips, they cannot become a profitable investment. There is probably no commercial enterprise which is so specialized and calls for such broad knowledge based upon experience and a careful study of the operations of successful competitors as the shipping business, and particularly that part of it which is concerned with foreign trade.

As everyone knows, our supreme wartime effort to counterbalance the submarine sinkings by an enormous output of shipping has left us in the possession of the second greatest merchant fleet in the world. We have the ships, and now the problem before us is to build up by every legitimate means a foreign trade, incoming as well as outgoing, which will keep our merchant fleet in full operation. The subject is a vast one, and we intend, just here, to speak merely of one very important phase of it, namely, that of the creation at our principal shipping centers of what are known as "free ports."

A free port is a zone or district which is excluded from the operation of a country's customs regulations. It is equipped with docks, piers, pier sheds, warehouses, and all the facilities for the loading and unloading of ships and the temporary storage of their cargoes. Also, within its strictly defined boundaries will be found various industrial establishments in which the raw materials that are unloaded in the free port may be worked up into various finished products. The advantages of such an institution are many. Cargoes which are brought to the port for reshipment to points outside of the country do not have to pay duty, *and they save the time and expense of haulage to ware*houses in the city. Instead of this, they are unloaded and stored in free-port warehouses adjacent to the docks, and can be reshipped abroad without the delay *and expense of passage through the customs.* Similarly, raw materials which ordinarily would have to pay duty can be brought to the free port, worked up into finished products, and exported free of duty. If *any part of the material so manufactured is destined* for home consumption, the duties are paid when they pass the free port boundaries.

The free port is no experiment. Its manifold ad*vantages have been proved in several of the leading* ports of Europe, notably at Hamburg, which is a model of its kind. Copenhagen, Stockholm and Christiania have all been set aside as free ports by their govern*ments. Because of her free trade policy, the whole of* England is one free port, and the beneficial results of the policy as worked out in that great maritime country are too well known to need any elaboration here.

In an illuminating article written by Edward N. Hurley for the Bureau of Economics, which has been founded for the study of California's public service industries, the advantages of free ports are stated very *forcibly. He draws attention to the fact that this* country is an importer of foreign made products which could well be assembled in a free port territory, both for sale in our own customs territory and for reshipment free of customs to other countries. The development of such industries would create not only an addition to the industry itself, but would tend to transfer to our own ports manufacturing and assembling, which would otherwise continue to be done abroad to the benefit of foreign labor and foreign capital. Everyone who takes a thoughtful and comprehensive view of the years of sharp commercial competition among the nations, which lie ahead of us, will agree with him that the United States Government should place American business upon the same competitive footing as that enjoyed by those protective tariff nations which have free port and free zone advantages.

We are glad to note that in the report of the New York-New Jersey Port and Harbor Development Commission a plea is made for the construction of one or more free-port districts at New York. A study has been made by commercial interests of the operation of free ports abroad and legislation has been introduced in Congress looking toward the establishment of such in this country. Investigations have been made also by Federal boards to determine the sentiment of this country toward the free-port project. The advantages of the system are so marked and so many that, once the people of this country become familiarized with the idea, there cannot fail to be a demand for the creation of free ports not merely at New York, but at all the leading seaports of the country.

Romance of Marine Salvage

THERE is something very appealing about the work of marine wrecking companies as we call them, or marine salvage companies as they are known on the other side of the water; so much so, indeed, that the stories which we have published from time to time of the operations of our own wrecking companies have always been welcomed and appreciated. The exigencies of the war, and particularly the submarine campaign, made a big demand upon the salvage companies to which they responded in right royal fashion, and the Liverpool Salvage Association has made a report which shows how positively amazing were both the activity and the successes of the salvage operations of the war. Thus, we learn that during the ill-fated Dardanelles expedition, of fifty-one vessels sunk near the beaches all were speedily reclaimed by the wrecking outfit of the association. Within a period of ten days in the month of June, 1917, four steamers, with a total deadweight of 30,000 tons, which had been torpedoed and sunk in the English Channel were brought into port. It will be remembered that the "Lion" was badly holed by gunfire during the running fight known as the Dogger Bank action, and it was one of the company's vessels, the "Ranger," which brought the ship in. This she did by building a coffer dam of timber backed by cement around the smashed armor plate, and putting the ship into a sufficiently watertight condition to get home. Another notable rescue was that of the "Britannia," a pre-dreadnaught battleship, which had torn open her bottom by stranding on the rocks of the Scottish coast. The hospital ship, "Asturias," which had been torpedoed, was saved by the salvage craft pumping out water from the ship at the rate of 12,000 tons an hour. It was the same vessel, "Ranger," that brought up "K 13," sister ship to the submarine recently lost during maneuvers, to the surface from a depth of 62 feet, and so rescued the crew after two and a half days' entombment on the sea bottom. So this one vessel steamed from one disabled vessel to another until she had covered in all 17,000 miles; and, not content with that war record, she did good work after the armistice in raising wrecked British ships that had been sunk in the attacks at Zeebrugge.

That such wonderful results can be accomplished is due to the fact that marine salvage is a highly developed art, requiring special plant and a wide practical experience. If you asked a wrecking expert what were his most helpful appliances, he would mention, doubtless, compressed air, the centrifugal pump and the free use of timber, planking, and concrete; but he would also tell you there is no cut-and-dried system that can be given general application. In other words, every wrecked ship is a problem in itself. Inventive skill may find methods superior to these, but for the present they control the situation.

Industrial Efficiency

Industrial Housing. — Among the latest advances in industrial housing are two model towns which have been erected by employees of the rubber industry at Akron, Ohio, known as Firestone Park and Goodyear Heights, the latter of which now has 18 miles of paved streets and is complete with shops, public buildings, and welfare institutes.

Prison Education. — A movement is on foot at Calgary, Alberta, for the establishment of a system in the different prisons of Canada to give some sort of business education to the inmates. A dispatch from London, England, to the effect that a movement is being started there to give men in Wandsworth jail a business education has given impetus to the endeavor. It is claimed that a number of prisoners lacked the facilities in youth to acquire education to make a living, have records of good behavior, and if they could be given some training while in jail would be better fitted to take their part in the world's work upon being released.

From Firearms to Automobiles. — The works of an Austrian arms manufacturing company in the city of Stepyr, Upper Austria, are now manufacturing high grade six-cylinder passenger automobiles and trucks by a new method. The end of the war found them with an equipment capable of producing 1,000,000 rifles and other small arms per year. Now they are making a few sporting rifles of the "Mannlicher" model and shotguns. During the war the works employed about 15,000 men; they now have about 6,000. Thus far the company has produced about 400 automobiles; it expects to produce 4,000 in 1921 and 10,000 in 1922, and to increase after that to 20,000 machines per year. It is said that the automobiles are in great demand, and are now sold in England, France, the Netherlands, Germany, Poland and Rumania.

Germany's Artificial Wool is prepared by a process which consists of compressing wool scraps which could not otherwise be utilized—shreds, ends, short fibers, washing wastes, etc., after treating them with certain chemical solutions. An investigation of the process develops the fact that experiments to that end were conducted personally by Herr Paul Krais, director of the chemico-physical section of the German Research Institute for the Textile Industry, at Dresden. Herr Krais is authority for the statement that the results of his experiments were unsuccessful, and that the application for a patent for this process has been abandoned. It appears that it is impossible to put the wool into solution without a resultant decomposition. In his experiments Herr Krais subjected to heavy pressure through tubes damp wool under high temperature, but the resultant threads did not possess the necessary tensile strength.

Reclaiming Waste and Wipers. — The wash and reclaiming equipment developed by a leading American laundry machinery company, makes it possible to reclaim waste some 10 to 15 times, and wipers some 20 to 30 times. The waste and wipers are first placed in a washer consisting of a horizontal rotating perforated cylinder mounted concentrically with a stationary cylinder. The washer is motor driven, and the interior is supplied with hot and cold water and live steam. Several changes of water are necessary, and the cleansing operation takes from 3/4 to 1½ hours. The drier consists of a centrifugal chamber in which the material is whirled for eight to ten minutes. This process extracts 90 to 95 per cent of the moisture, and the waste is then ready for drying. The drying machine is asbestos lined, and the air passing through it is first heated over steam coils and then forced by a fan through the waste. It is said that the reclaimed waste is as soft and as absorbent as when new.

Peat as Railroad Fuel. — Tests extending over several months have passed the experimental stage and conclusively demonstrated that peat, reduced to powder or prepared in the form of briquets, makes an excellent substitute for coal as fuel for locomotives. The Railway Board of Sweden, satisfied with the results of these long-continued tests on the State railroads, has recently taken over the specially constructed plant at a bog near Vislanda, with a capacity of 30,000 tons per annum. The machinery employed is well adapted for the purpose of converting peat into a cheap and effective fuel with a minimum working force. The peat is dried in the open air as far as possible. Only the hardest and driest lumps are used for ordinary fuel, the remainder being converted into powder or briquets. The plant was originally intended for the manufacture of peat powder, but it was found that briquets were as well adapted for fuel, hence both are now being made. The discovery was also made that powdered peat becomes a dangerous explosive when subjected to high temperature.

Science

A New Type of "Boll Weevil" has turned up. This is a date scale which must be eradicated or the entire date industry of the United States will be wiped out in two or three years.

A Livingstone-Stanley Memorial. — The tree where Stanley met the great English missionary-explorer on November 3, 1871, at Ujiji, in what was formerly German East Africa, is now marked by a stone inscribed "Livingstone-Stanley—1871." It affords a convenient resting place for the irreverent natives.

Overalls vs. Paperalls.—England is being supplied with apparently good blue overalls. Everything seems all right until the laundry is called in to rejuvenate the garment, then it is found that Germany has been up to her old tricks and the fatal bath leaves only the buttons and the linen pockets, for all the rest is paper cleverly masquerading as blue jeans.

Fields To Be "Classrooms."—Application has been made for a charter for a Pan Pacific university where the "classrooms" will be the sugar and pineapple fields throughout the Hawaiian Islands. Work will begin in the labor camps of all the islands of the group. The instructors will be sent to the students, instead of waiting for the students to come to them. Similar work has been carried on in Porto Rico, with great advantage to the island, the agricultural experiment station and school being located at Mayaguez.

The Dangers of Occultism.—A Psychical Research Society composed of eminent professors and those interested in the scientific aspect of the subject has been formed in Glasgow. The founders caution those of untrained minds that is not a science to dabble in and nothing of a sensational nature will be published or tolerated. Prof. Latta emphasizes the danger of occultism to people who are incapable of making sharp distinctions, as they might jump to alarming conclusions which would result in a neurasthenic condition of mind.

Recent Egyptian Find.—Thousands of mummified bodies of the sacred ibis have been found by the French savant, M. Lacau, in the underground necropolis of the famous ruined temple at Deir Medineh, Egypt. Each bird was in an elaborately decorated vase of earthenware embedded in a sort of cardboard formed by a conglomeration of papyri which totaled hundreds of thousands of written documents. M. Lacau says the find was one of the most important of the late discoveries in Egyptology. The work of deciphering the documents will take years.

Age of the World.—The Abbe Theodore Moreaux, Director of Observatory at Bourges, has recently given some estimates of the age of the earth and when the phenomenon of life appeared on it. He considers 500,000,000 years about right for the age of the earth and he thinks that the temperature dropped to a point where life could exist about 250,000,000 years ago. Man was a comparative newcomer and the Abbe gives only some tens of thousands of years, thus refuting an estimate of a German scientist, who recently gave 400,000 years as the probable period for the advent of man.

A "Weedless Lawn."—A long-sought fertilizer has at last been secured after twenty years of research which will slowly and surely extirpate the weeds, while permitting the grass to grow freely. Ammonium sulfate is found to be more advantageous than sodium nitrate, which tends to create an alkaline condition of the soil, especially favorable to the propagation of weeds. Ammonium sulfate produces reversed conditions and the grass flourishes and the weeds are so weakened that they are crowded out. Of course this plan of fertilization must be qualified, as only grass that is an acid tolerant would develop along the line of extirpation of the weeds. The weeds to resist must be non acid tolerant also.

Papal Land Reclamation.—The Papal authorities are trying to induce capital to invest in a reclamation scheme for the irrigation and consequent reclamation of the Pontine marshes. The chief town in the area is Ostia, which in 50 B. C. was one of the principal cities of Italy, but in the first century A. D., deposits from the Tiber silted up the harbor and ruined the city. Then came malaria which rendered the whole tract very unhealthy. The idea is to build another city near Ostia to relieve the housing situation in Rome, the distance would be only about nineteen to twenty miles. This would give Rome a maritime port which she needs badly. The engineering charges would be borne in connection with the reclamation work of the Pontine marshes. About $50,000,000 would be required for the reclamation work. The acreage which would be salved is very large, but the cabled reports as to the exact quantity of land involved is misleading.

Automobile

The Automobile Industry.—The automobile business is the largest manufacturing business of finished goods in the world, says *Machinery*, in a recent issue. This year the total volume of the automobile, accessory and supply business in this country alone will reach $4,400,000,000, of which over $2,000,000,000 will represent passenger cars and trucks. There is one car in use for approximately every 13 persons in the United States, as compared with one for every 2,182 persons in the rest of the world—268 in England, 402 in France, 684 in Germany, and 5,300 in Russia. Europe has 449,000,000 people and only 437,000 automobiles. It is estimated than 45 per cent of the automobiles sold in this country are bought by farmers and the inhabitants of small towns. The average life of a car is estimated at five years. There are about 800,000 trucks in operation in the United States, hauling an average of 1½ tons per day each, *which amounts to a total of* 3,000,000 tons per day, or 360,000,000 tons per year. Figures show that the average ton-mile cost of motor truck haulage is 18 cents, as against 0.96 cent by railroad locomotive, but the railroad terminal charges are large, and time is saved by the motor truck. Haulage by horse is estimated to cost 24 cents per ton mile, and it is said that truck haulage has released 3,600,000 horses for various other purposes in the United States. The automobile accessory and supply business, including tires, gasoline and oil, has reached a volume greater than that of the automobile business itself.

Spark Plug Location Important.—Many cases of ignition trouble have been traced to the use of improper spark plugs or to faulty location of these members. Manufacturers of spark plugs have given the matter of location considerable thought during recent years, and the endeavor is to produce a plug specially designed or adapted for the motor for which it is to be used. The spark plug shell or base is constructed so the spark points will project into the combustion chamber. It is also important to make provision for proper cooling of the spark plug. This last named factor is an important one that is seldom given consideration by owners or repairmen who change the spark plugs without making sure that they are adapted to the motor. To obtain the greatest efficiency from the explosion it is important that the spark points project into the combustion chamber in such a way that they be surrounded with cool fresh gas. If the gap of the plug is located in a recess or pocket, dead gas is apt to accumulate about the points, and combustion will be much slower than it would be with the spark plug, so the spark points project into the intake chamber, permitting the spark to take place in fresh mixture and promote rapid spread of the ignition flame. It will be apparent that with a projection from the plug body having a space around it in which the hot gases may collect, the plug will heat up much quicker than the mounting in which the heat will be conducted away by the cooling water. A plug that becomes heated will tend to soot up and carbonize much quicker than one in which provisions have been made for proper cooling.

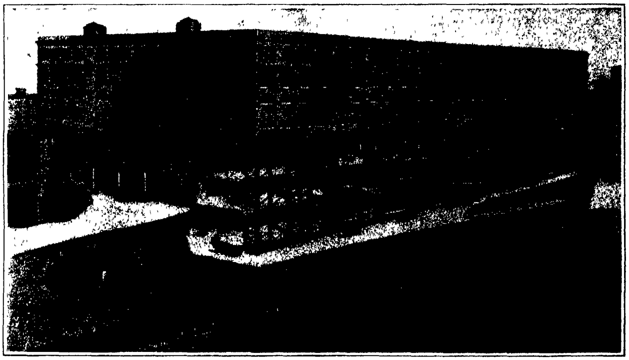
Composition of Automobile Exhaust Gases.—A. C. Fieldner, speaking before the Chemical Society of Washington recently, reported an extensive series of investigations made by the Bureau of Mines on the composition of automobile gases in relation to ventilation of vehicular tunnels. This work has demonstrated a number of important conclusions as to the extent of incomplete combustion in automobile engines. An average of about 6.4 per cent carbon monoxide in the exhaust gases from all types of machines tested for all conditions of test is reported. With the proposed vehicle tunnel from Manhattan to New Jersey this represents at the full capacity of the tunnel a discharge of about 400 cubic feet of carbon monoxide per minute, which would require for proper elimination the movement of approximately 1,000,000 cubic feet of air per minute. The percentage of carbon monoxide in the exhaust varies widely with the adjustment of the carburetor and the conditions of driving. The largest percentages of carbon monoxide are formed when accelerating or climbing grades—that is, at the time of greatest power demand. The point of maximum power production from an engine is quite different from the point of maximum thermal efficiency. At the point of maximum power richer mixture is used than corresponds either to the point of maximum thermal efficiency or to the point of theoretical air-gasoline ratio. As a practical matter, the best remedy for gasoline losses caused by inefficient operation is, in the opinion of Dr. Fieldner, to be accomplished only through more extensive use of dash control devices so that the richness of the mixture can be adjusted by the driver according to the power demands.

Reorganizing the Port of New York

Port Commission Plan for Modernizing the Railroad and Shipping Facilities of New York

THE report of the New York-New Jersey Port and Harbor Development Commission recently made public deals with this vast and complicated subject in a most comprehensive way, and were it not for the fact that it proposes the expenditure of 200 million dollars upon a tunnel system of limited capacity we should *feel prepared to give the report our unqualified endorsement* This phase of the subject is discussed at some length on our editorial page

The report contains three major proposals first the creation by agreement between the two States of a Port Authority with jurisdiction over the entire Port District, so constituted as to enable it to carry out a continuous policy second the construction of three *belt lines of standard railroad to be known as the* Outer, Middle and Inner or Waterfront Belt Lines and third, the construction of an electrically operated system of tunnels connecting a transfer yard in the Jersey meadows with a tunnel belt line beneath Manhattan Island, to be used exclusively for the transportation of food and general merchandise The first two of these proposals should receive unqualified endorsement *the tunnel proposal should be rejected on the* ground that its scope is too limited, inasmuch as it deals with a portion only of the freight traffic and makes no provision whatever for long distance express and local passenger traffic, nor for continuous trolley service nor for the enormous and ever growing automobile and motor truck traffic between New York and New Jersey



At the tunnel level is an eight-car, crewless, electric train, just arrived from the Jersey transfer yard. The cars are raised, one at a time, by elevator to the desired floor of the terminal warehouse Here the small 8′ by 6′ trailer cars, *containing the merchandise are wheeled out of the electric cars* for distribution of their contents in the warehouse or to motor trucks

Typical automatic-electric terminal of the proposed freight tunnel

The Three Railroad Belt Lines

In order to secure a perfect distribution of *incoming and outgoing* railroad freight and enable a car coming in over any particular road to be hauled direct to any point on the waterfront of New York, the Commission recommends the building of the three belt lines which are shown on the front page of this issue The outer belt line starts from the Hudson River at Piermont, about twenty-five miles north of the Battery, makes a broad sweep through the country lying back of Jersey City at a distance of from ten to fifteen miles from the North River waterfront crosses to Staten Island and swings round to a connection with a waterfront railroad belt line which extends along the easterly shoreline of that island It is proposed ultimately to run a branch from this outer belt, leaving it near Springfield, New Jersey and running easterly to a tunnel which will extend from the Jersey shore to the Long Island shore there to connect with the Middle Belt Line This Middle Belt Line will utilize the existing Long Island Railroad and the New York connecting railroad, thereby giving an extension by way of Hellgate Bridge through the Bronx to the New York Central tracks at Spuyten Duyvil

Cooperating with the Outer and Middle Belt Lines as above described will be a system of inner or waterfront belt lines, one extending from the Outer Belt Line south through Perth Amboy and *along the Raritan* River, another serving the westerly and easterly waterfront of Staten Island Moreover, there will be other sections encircling Jamaica Bay, Flushing Bay, and the southerly shore of the Bronx and there will be three separate sections serving the Brooklyn waterfront along the East River and the upper bay All of these sections of the waterfront belt system will, of course, have direct connection with existing lines In Jersey City, furthermore, there will be a belt running along the waterfront from Fort Lee to Bayonne, a second inner belt extending from Leonia on a course generally parallel and two miles to the west of the Jersey City waterfront, and a third inner belt extending from the neighborhood of Ridgefield Park, in a southerly direction to Elizabethport

Heavy Railroad Freight Traffic

Twelve *railroads reach the* Port of New York Nine of these terminate in New Jersey or Staten Island, and three of them enter from New York State and terminate in Manhattan Of the 76,052,000 tons of freight moved into, out of or through the Port District in 1914 by the railroads, 53,359,000 tons were brought in by rail Of these 53,359,000 tons of freight, 34,345,000 tons consisted of fuel and ore Also, there were 4,000,000 *tons of* grain and mill products another 4,000,000 tons of other foodstuffs, and yet another 4,000,000 tons of building materials The remaining 6,717,000 tons were classed as miscellaneous Practically all of the fuel and ore tonnage was distributed locally by lighter, about 50 per cent of the miscellaneous freight was handled by car-float, and 40 per cent of the foodstuffs other than grain was also handled by car-float

Under *existing conditions, the various railroads* run to their own freight terminals at the waterfront, and there is practically no means by which freight cars coming in by one railroad can readily be transferred by rail to any other railroad for transport to its destination The construction of these belt lines will solve that problem at a stroke, by rendering our whole railroad system at the Port of New York thoroughly fluid or elastic

Automatic Electric Tunnel System

The essential elements of this system which is designed *for meeting the* food and general merchandise, or less-than-carload lot, traffic (shown in dotted white lines on our birdseye view) are: (1) a belt line railroad in New Jersey reaching all of the New Jersey railroads that give pier-station service, (2) a joint yard and transfer station on this belt line; (3) two parallel standard-gage tracks running in a loop in separate tunnels from the New Jersey yard to Manhattan *and back*, (4) *a series of multiple-story freight* terminals above the loop in Manhattan, with car elevators from the deep tunnel to the street surface, (5) a separate connection and transfer station in Manhattan for the New York Central Railroad, (6) a fleet of special electrically-operated cars with a fleet of small four-wheel trailer trucks

At the transfer yard of this electric tunnel system in New Jersey, there *will be twenty-four long parallel* platforms, each with a standard railway track on one side and an automatic electric track on the other side. The freight will be unloaded from the standard railroad car into small trailers, which measure three feet by six *feet, and the trailers will be hauled along the platform* and loaded side by side into the automatic electrical cars, each of which will hold twelve trailers and will be somewhat larger than the ordinary box car. These cars will be made up into trains of eight, which will be operated electrically and automatically, and will run at an average speed of 13.2 miles per hour through a tunnel below the Hudson River which will emerge in the neighborhood of 47th Street, Manhattan This tunnel will be built at a depth of about 80 feet below street surface, so as to avoid interference with future extensions of our subway system. The tunnel will extend southerly below Manhattan Island from 47th Street to the Battery, and at intervals there will be located above it at street level, large storage and distributing warehouses The cars, each with its load of twelve trailers, will be raised one at a time by an electric elevator to the warehouse level, where the 8 ft. by 6 ft trailers will be run out to the platforms. The empty cars will be moved forward to the other end of the building where they will be lowered by elevator to the tunnel level, and returned to the New Jersey distributing yard by way of a tunnel below the Hudson River at the Battery There will be no train crews, the movement of the trains being entirely controlled at a central dispatcher's office

Such, in brief outline, is the system by which the Commission proposes to handle the distribution of foodstuff and light merchandise. It is estimated that the total cost of this system, which will serve Manhattan from Central Park to the Battery, will be slightly over 200 million dollars. The rectangular loop shown on our map embracing Central Park and extending to Harlem, with a distribution yard located on Ward and Randall's Island, *is not included in the present scheme*, but will be constructed when the present plan has proved itself in practical operation The cost of the upper loop, together with its Hudson River tunnels, distributing yard, et cetera, will probably be about equal to the cost of the first system, or approximately $200,000,000, making a total of $400,000,000.

Kind of Traffic To Be Handled

It is the opinion of the Commission that virtually all the traffic now handled at the railroad pier stations and at the freight houses of the floatbridge terminals can be handled economically by this system The heavy freight of the float-bridge terminals cannot be accommodated in the proposed tunnels and these terminals, it is *considered*, should be retained. The St. John's Park terminal of the New York Central and the New York Central tracks in Tenth and Eleventh Avenues would be removed. The new system would be able to handle the milk supply and other perishable food; it would be well adapted to the handling of express packages, and it is believed that because of the absence of delays, and the expeditious and well-organized delivery at the twelve warehouses in Manhattan, the food will be received in New York in a far more fresh and wholesome condition than under the existing methods.

An Excellent Plan, but Too Limited

There can be no doubt that if this new automatic tunnel system develops no unforeseen defects, it will be an admirable method of handling that part of the traffic at this port which is included under the general description of less-than-carload lots, such as food

(*Continued on page 235*)

Better Railway Ticket Selling

By Ralph Howard

EVERYBODY remembers the old-fashioned ticket racks in the railroad station, which held through tickets stretched out at full length; and everybody has seen the agent drag forth the desired form from one of these racks, much as a protesting earthworm of gigantic proportions might be dragged, unwillingly, from its hole. But this sort of thing is now of the past, and with it the necessity of the ticket agent's walking the length of a large room in search of a through ticket to Salina, Kan., via Lackawanna, Wabash and Rock Island, or some other cruel and unusual combination of routes which the itinerary of the would-be passenger might call for. The New York Central has had in operation for a sufficiently long time to demonstrate its success, a brand new system, based upon the "portable ticket case." By this system, according to its present sponsors, a passenger may be accommodated with any kind of ticket—railroad, through or local, Pullman sleeper or parlor car, to any point—at one window. It involves combining in one compact cabinet—three feet nine inches wide, two feet deep and seven feet high—any and all tickets a traveler may need. In it the long through tickets are folded for the first time, instead of hanging on hooks at a lengthy general case used by all sellers, which meant extra steps for all clerks.

Every ticket—over 3,000 forms in all—is at the seller's elbow. Where the clerk used to walk 10 to 100 feet, while the buyer fumed, the ticket is now within reach. A statistical sharp figured that—with 30 feet the average round-trip of a clerk for a long-distance ticket form in the forty largest city terminals—the elimination of this trip will save, together with the passenger's journey to another ticket window, several hundred thousand steps each working day.

This new ticket case, tested and now used at Grand Central Terminal, New York, has greatly relieved congestion at three ticket windows, and the long queues of impatient waiters often seen at depots.

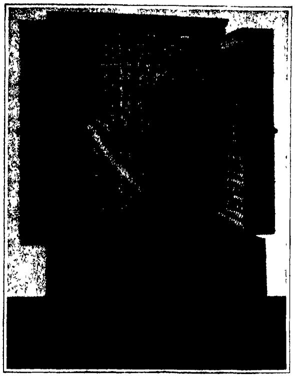
The new system has so increased capacity and efficiency that the building of additional windows—at a cost of a quarter of a million dollars and sacrifice of architectural beauty—has been rendered unnecessary at Grand Central, and the public is receiving an unprecedented service.

The new ticket case permits a flexible system by which capacity may be expanded instantly, to care for the rare "peak load" of travel. Each case is a complete rolling ticket office and, if demanded, a score can be placed in the open concourse to take care of football or holiday crowds.

The New York Central has thirteen ticket windows at Grand Central Terminal—five through or interline, five local, and three Pullman. Formerly three clerks joined in using Pullman and through railroad ticket cabinets, involving a walk from the buyer to case and return of as much as forty feet. Now each clerk has his own case containing every kind of ticket at his elbow; he need never leave his customer, and his steps and the traveler's patience are conserved.

Formerly when ticket clerks changed, the window was closed and the station put out of service, while the accounts were audited. The new case makes this unnecessary, the result being that each window is available for use 100 per cent of the time, greatly increasing the capacity of the office.

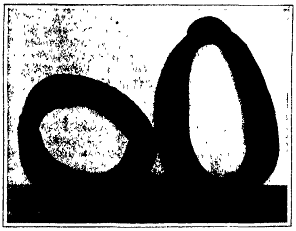
The New York Central's lead in this improvement already is being followed, and the portable case system has been approved for installation in the Union Station at Washington, D. C., at Pennsylvania Station, New York City, and other large centers.



The compact portable ticket case that takes the place of the inconvenient racks of long familiarity

Rats and Canvas

IN the eternal struggle against the depredations of pack rats and other rodents, the Mount Rose Observatory has found where tin or close-meshed wire netting is not easily available, that heavy canvas bags are the most feasible receptacles for bedding and any material whose smell is not pungently attractive. On only two occasions in fifteen years have rodents gnawed through canvas. Other fabrics, however, are no barrier and paraffin proofing is a positive attraction. Washing powders are no deterrent to consuming the paraffin cartons in which they are placed.



This horse-collar has a capacity of several quarts of illicit "hootch"

Outwitting the French Customs

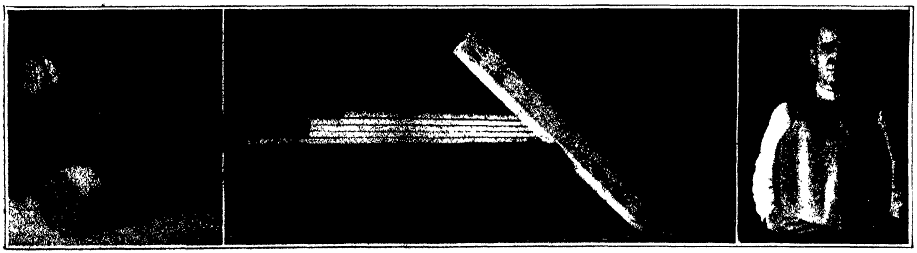
By George F. Paul

WAR has evidently sharpened the wits of the Frenchman in and around Paris who make a practice of bringing produce of various kinds through the city gates. For years it has been the custom to have men stationed at the different gates to collect the taxes imposed on certain products brought into the city. These officials sometimes grow a trifle lax in their inspection, especially when the driver of the wagon or truck is an old friend that they trust. As the war progressed and as the price of necessities, especially oil and wine, steadily rose in Paris, some of the drivers began to scratch their heads and wonder if they couldn't devise some innocent looking receptacles that they might take through the city gates every day right under the very eyes of the inspectors and yet not be caught in the act of smuggling taxable goods.

Accordingly they began to exercise all of their inventive genius and presently they had evolved many queer receptacles that varied in capacity from a few quarts to several gallons. The men at the octroi stations were deceived for several weeks by the boldest of these men. He was always very cordial with the officials and sought to win their good will by giving them tobacco and other presents from time to time. Presently rumors reached them that he was smuggling oil into the city every day. This put them on the alert with the result that the following day when he appeared as usual with his innocent looking load of lumber, they began to tear it all apart. In vain did he protest that he was late even then and that he simply had to hurry on. This only made them the more determined to go through his whole load. Presently they came to five boards that were nailed together in a manner that aroused their suspicions and on examining them closely they found that the top board simply covered an opening through which a tin receptacle nearly five feet long could be passed to the snug place of concealment hollowed out for it. The driver, who had been very indignant and blustering up to this point became very meek and penitent when several gallons of smuggled oil were confiscated. While this examination was in progress one of the police noticed that the horses wore remarkably large and peculiar collars. He ordered the driver to remove the collars from the horses necks and when this was done it was discovered that the collars were hollow and so fitted up that they could hold oil. Needless to say the career of this particular man as a smuggler ended that day.

This experience seemed to arouse the inspectors at all of the city gates. They almost turned wagons and carts upside down in their efforts to detect any smuggling. One of their first hauls was a magnificent funeral wreath that seemed uncommonly heavy. When some of the flowers were removed and a tap unscrewed, three jugs were filled with the wine that was being smuggled through. Some abnormally large cabbage heads were examined closely; each contained nearly a quart of wine in a flat flask hidden in the heart of the cabbage. Rolls of cloth also aroused the suspicions of the inspectors. These rolls were found to have genuine cloth at the ends so as to present the proper appearance, but in the middle was a handy receptacle capable of containing several bottles of wine or oil.

Even the cushions on which the drivers sat were pressed into the smuggling service. Of course they were made hollow and filled with flat tanks that were not comfortable, but the drivers did not care, so long as these cushions proved money makers.



Left: Carefully prepared rolls of cloth or carpet that contain smuggled goods, solid or liquid. *Center:* Boards nailed together may conceal a tank of considerable capacity. *Right:* Breastplate covering for the smuggler, under which he can carry goods that would give him away if their contour were exposed

Some of the dodges of the French smugglers entering the city of Paris

From the Einstein Contest—IV

The Principle of Relativity—A Statement of What It Is All About, in Ideas of One Syllable

By "Shinglewood" (Hugh Elliot, Chislehurst, Kent, England)

THE invariance of the laws of nature was one of the most popular themes of nineteenth century philosophy For it was not till last century that general acceptance was accorded to the doctrine of the "Uniformity of Law," adumbrated in ancient times by Epicurus and Lucretius It is now a cardinal axiom of science that the same cause in the same conditions is always followed by the same effect There exists in nature no indeterminate element, all things are governed by fixed laws, and the discovery of these laws is the main business of science

[It is necessary to guard against reading into this statement an erroneous idea of the content of a "law of nature" Such a law is of course not an enactment of any sort, and it is not even to be thought of as an actual explanation of the how and why of the phenomena with which it has to do It really is nothing but an expression of our belief in the pronouncement of the preceding paragraph that like conditions do produce like results It is a prediction based on past experience, and is of value merely in that past experience leads us to credit its accuracy The composite essay by nine contestants and the Einstein Editor, which appeared in the SCIENTIFIC AMERICAN *for March 5th, discusses this question of the reality of natural laws, and should be consulted in connection with the present contribution]*

This great philosophic principle was derived of course from the study of natural science i e, from observations and experiments conducted upon the *earth* Their comprehensiveness is therefore limited by the fact that the observer is always in a state of rest, or nearly so, as compared with the earth All observers upon the earth are moving through space at the same velocity and it was possible to argue that the uniformity of law might only hold good, when experiments were conducted at this velocity An observer moving at very different velocity might discover that the laws of nature under these new conditions were somewhat different

THE essay by "Shinglewood," presented herewith, is probably the second-best produced by the Einstein contest It was the last one eliminated by the Judges, being the only one that seemed adequate to accompany the winning essay of Mr Bolton in taking precedence over that of Dr Murnaghan, which appears in the current SCIENTIFIC AMERICAN MONTHLY; *and it is certainly third to no other essay than Dr Murnaghan's It will be seen to be distinctly more elementary in tone than Mr Bolton's. Indeed, had it not been for Mr. Elliot's unfortunate concluding paragraph which we have suppressed, his uncertainty on the fundamental character of a natural law on which we have commented, and his tendency by way of emphasis to say the same thing in too many different ways, his greater simplicity of outline might have carried him through. In any event, his essay is emphatically a contribution to the popular literature of relativity*—THE EINSTEIN EDITOR

Such a view could indeed never be very plausible, for motion is only a relative conception Imagine a universe consisting of infinite "empty" space, in which there is poised a single material body How shall we determine whether this body is at rest, or whether it is moving at high or low velocity through space? It is never getting nearer to anything or farther from anything, since there is no other body for it to get nearer to or farther from If we say it is moving at a uniform velocity of a thousand miles a second, our statement really has no significance We have no more *reason* for affirming that it is in *motion* than we have for affirming that it is at rest In short, there is no such thing as absolute motion the conception of motion only arises when there are two or more bodies changing their position relatively to one another This is what is meant by the relativity of motion It seemed therefore improbable that the laws of nature would be different if the observer were moving at high velocity, for the movement of the observer is not an absolute quantity, but merely a statement of his relation to other bodies, and if there *were* no other bodies the statement itself would be meaningless

Now among the established laws of nature is that which specifies the velocity of light moving through a vacuum If the laws of nature are invariable, this velocity will always be the same But consider what would happen under the following circumstances Suppose that we are at rest, and that an observer on another body flies past us at 150,000 miles a second Suppose that at the moment he passes a piece of flint projecting from him grazes a piece of steel projecting from us, giving rise to a spark and that we both thereupon set about to measure the velocity of the light so produced After one second, we should find that the light had traveled about 186,000 miles away, and since during this second the other observer had traveled 150,000 miles, we should infer that the light traveling in his *direction* was only about 36,000 miles ahead of him We should also infer that he would find this out by his experiment, and that he would estimate the velocity of light as only 36,000 miles a second in his *own* direction, and 336,000 miles a second in the opposite direction. But if this is so, then that law of nature which specifies the velocity of light is quite different for him and for us the laws of nature must be dependent upon the observer's motion—a conclusion which appears incompatible with the idea of the relativity of motion.

And it so happens that it is also contradictory to experimental conclusions Experiments undertaken to settle the point show that each observer finds the same velocity for the light of the spark, and after one second, each observer finds that the light has traveled 186,000 miles from himself But how is it possible that when it has traveled 186,000 miles in the same direction as the other observer who himself has moved 150,000 miles meanwhile, he should still think it 186,000 miles ahead of him? That is the initial paradox, and since there has been no room for error in the experiments, we are forced to conclude that there was something wrong in the assumptions and preconceptions with which we started

There can in fact be only one interpretation If we each find that the light has moved the same number of miles in the same number of seconds, then we must be meaning something different when we speak of miles and seconds We are speaking in different languages Some subsidence has occurred in the foundations of our systems of measurement We are each referring to one and the same objective fact, but since we describe it quite differently, and at first sight incompatibly, some profound alteration must have occurred in our perceptions—all unsuspected by ourselves It has been shown precisely what this alteration is A body moving at high velocity must become flattened in the direction of its motion, all its measuring apparatus, when turned in that direction, is shortened, so that no hint of the flattening can be obtained from it Furthermore, the standards of time are lengthened out, and clocks go slower The extent of this alteration in standards of space and time is stated in the equations of the so-called Lorentz transformation

We are accustomed to describe space as being of three dimensions, and time as being of one dimension As a matter of fact, both space and time are "ideas," and not immediate sense-perceptions We perceive matter, we then *infer* a universal continuum filled by it, which we call space If we had no knowledge of *matter* we should have *no conception of space* Similarly in the case of time we *perceive* one event following another, and we then invent a continuum which we call time, as an abstraction based on the sequence of events We do not see space, and we do not see time They are not real things, in the sense that matter is real, and that events are real They are products of imagination · useful enough in common life, but misleading when we try to look on the universe as a whole, free from the artificial divisions and landmarks which we introduce into it for practical convenience Hence it is perhaps not so surprising after all that in certain highly transcendental investigations, these artificial divisions should cease to be a convenience, and become a hindrance

Take for instance our conception of time. It differs from our conception of space in that it has only one dimension. In space, there is a right and left, an up and down, a before and after. But in time there is only before and after. Why should there be this limitation of the time-factor? Merely because that is the verdict of all our human experience. But is our human experience based on a sufficiently broad foundation to enable us to say that, under all conditions and in all parts of the universe, there can be only one time-direction? May not our belief in the uniformity of time be due to the uniformity of the motion of all observers on the earth? Such in fact is the postulate of relativity. We now believe that, at velocities very different from our own, the standard of time would also be different from ours From our point of view, that different standard of time would not be confined to the single direction fore and aft, as we know it, but would also have in it an element of what we might call right and left True, it would still be of only one dimension, but its direction would differ from the direction of our time It would still run like a thread through the universe, but not in the direction which we call straight forward It would have a slant in it, and the angle of the slant depends upon the velocity of motion. It does not follow that because we are all traveling in the same direction down the stream of time, therefore that stream can only flow in the direction which we know "Before" and "after" are expressions which, like right and left, depend upon our personal situation. If we were differently situated, if to be precise we were moving at very high velocity, we should, so to speak, be facing in a new direction and "before" and "after" would imply a different direction of progress from that with which we are now familiar

But, after all, the objective universe is the same old universe however fast we are moving about in it, and whatever way we are facing These details merely determine the way we divide it up into space and time The universe is not affected by any arbitrary lines which we draw through it for our personal convenience For practical purposes, we ascribe to it four dimensions, three in space and one in time Clearly if the time direction is altered, all dimensions both of space and time must have different readings. If, for instance, the time direction slopes away to the left, as compared with ours, then space measurements to right and left must be correspondingly altered An analogy will simplify the matter

Suppose we desire to reach a point ten miles off in a roughly northeasterly direction We might do so by walking six miles due east and then eight miles due north We should then be precisely ten miles from where we started. But suppose our compass was out of order, so that its north pole pointed somewhat to the west of north Then in order to get to our destination, we might have to walk seven miles in the direction which we thought was east, and a little more than seven miles in the direction which we thought was north We should then reach the same point as before Both observers have walked according to their lights, first due east and then due north, and both have reached the same point the one observer is certain that the finishing point is six miles east of the starting-point, while the other is sure it was seven miles

Now we on the earth are all using a compass which points in the same direction as regards time But other observers, on bodies moving with very different velocity, have a compass in which the time-direction is displaced as compared with ours. Hence our judgments of distances will not be alike. In our analogy, the northerly direction corresponds to time, and the easterly direction to space, and so long as we use the same compass we do not differ in our measurements of distances. But for anyone who has a different notion of the time-direction, not only time intervals but space distances will be judged differently

In short, the universe is regarded as a space time continuum of four dimensions. A "point" in space-time is called an "event"—that which occurs at a specified moment and at a specified place. The distance between two points in space-time is called their "interval." All observers will agree as to the magnitude of any interval, since it is a property of the ob-

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The Balky Motor

Some of the Things to Look for When the Automobile Refuses to Do Its Duty

By Victor W. Pagé, M.S.A.E.

THERE is nothing more annoying to the average automobile owner than motor trouble along the road, and while this can be prevented in most cases by careful and systematic inspection before starting on a trip there are certain minor difficulties that are apt to occur no matter how careful the motor is looked over If a motor refuses to start after operating in the proper manner for a considerable time the difficulty is usually one of minor importance that can be located quickly by a systematic investigation of the various auxiliary parts which are necessary to motor operation Many motorists immediately start to change the carburetor adjustment when trouble occurs, but this should not be done until the following points have been checked over *and it is determined that the carburetor is* really at fault First make sure the gasoline is reaching the carburetor float chamber and that it is pure gasoline and not water and rust that fill that member Open a drain cock under the spray nozzle, or detach the gasoline coupling at the float chamber to allow any water or sediment that may have collected at those points to drain off. If the engine is not provided with a priming device make sure that gasoline reaches the cylinders by injecting some through a priming cock or the opening obtained by removing the spark plug Next make sure that a spark occurs by detaching the secondary wire or high tension cable from the spark plug terminal and hold it about one-eighth or one-quarter inch away from some metal part of the motor while it is cranked Watch for a spark to jump the gap as the motor is turned over, then try the compression of each cylinder by using the emergency hand crank instead of the starter, turning off the ignition switch and opening the throttle wide A decided resistance to cranking should be felt in each cylinder as the piston reaches its compression point The next *thing to do is to check over the spark timer, to make* sure that the spark occurs when the piston in each cylinder has reached the end of its compression stroke and before it starts back on what is normally the power stroke If the gas reaches the cylinders and the compression is good and the electric spark takes place at the right time there is no reason why the engine should not start easily unless conditions are extremely *unfavorable, such as a very cold motor or one with dry* pistons

If the inspection has disclosed that there is gasoline in the float chamber that the ignition switch is on and the ignition spark occurs at the plug and the motor still refuses to start the following suggestions may be of value The choker valve does not close The choker may have been used too much and the cylinders flooded with gasoline in which case the engine *must be cranked with the choker and the priming cocks* open till gasoline excess is removed The spark may be timed wrong by having the rotor member in the timer moved around so that it occurs in the cylinder that is not on the compression stroke One of the valves may fail to close properly or the valve spring may be broken The exhaust valve may be leaking badly. The valves may be timed wrong—a very rare occurrence The battery may be weak The spark plugs may be badly sooted or have too large a gap between the plug points. The gasoline may be of very poor quality The spark may not be far enough advanced

If the ignition has been found to be faulty which condition is determined by ascertaining that no spark occurs at the spark plug gap when the test is made, the following points should be given consideration the battery may be dead or one cell of the battery may have failed A test should be made with a metal connection across individual cell terminals The battery ground connection may be broken There may be a broken connection or short circuit between the battery *and the ignition contact breaker Test for spark at the* breaker point and make sure that the resistance unit on the timer or induction coil is not burned out or broken There may be a short circuit of the high tension current due to moisture in the distributor block or on the spark plug insulators The spark plug wires may be arranged wrong This last is only possible when the wires are practically all of the same length *and not carried in a good tubular conduit*

If the motor starts but refuses to keep running the trouble may be caused by wrong manipulation of the carburetor dash control and failure of the choker valve to return to its open position Partial obstruction in the fuel supply line which permits the gasoline to feed through but not in sufficiently large quantities to keep the engine running after it has started Water or dirt in the supply pipe or carburetor Dirt or water in the vacuum *tank* outlet Sticking intake valve Loose ground connection or poorly made connection at the battery Loose terminals anywhere on the primary wiring of the ignition circuit The idling passage in a compound nozzle carburetor may be clogged

If the motor will start, keeps running but runs irregularly because it misses explosions in certain cylinders at all speeds look for the following defective conditions Dirty or carbonized spark plugs cracked spark plug insulator or improperly set gap at the plug points Short circuited spark plug wires which can be detected by listening for the crackle of a jumping high tension spark or visually by running the engine in the dark Wires interchanged on two or more spark plugs Inlet or exhaust valves sticking in guides or held open by lack of proper tappet clearance Trying to run with the motor very cold or using low-grade gasoline A leak in the cylinder-head gasket

If the motor starts and keeps running but operates irregularly at ordinary driving speeds look for Sooted or cracked spark plugs Intake or exhaust valves not seating tightly Gasoline leaking into the intake manifold through *the suction connection* of the vacuum tank Air leaking into the mixture

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Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

Early Use of Compressed Air for Salvaging Ships

To the Editor of the SCIENTIFIC AMERICAN

When practising law in London in 1874 or 5 an engineer about 30 years of age came into my office one day with a personal introduction He told me that his business with me was to have me prepare for him and his associates contracts for raising several ships and also a great floating dock, all recently sunk in the entrance to the harbor of St Thomas, in the West Indian Island of that name, in a terrific hurricane He went on to explain that the floating dock in question had been constructed specially for the repair or reconstruction of Royal Mail steamships, having headquarters at St Thomas He said that this dock had been built in Great Britain, had been towed across the Atlantic to St Thomas, and had been wrecked at the harbor entrance and had blocked the entrance, and that seven ships of varying tonnage, one a new steamship of, I think, 1,500 or 2,000 tonnage, were left there in a tangled mass

I asked him what agency he proposed to use for so gigantic a task He answered: "Compressed air led into the holds of the vessel as soon as the divers had made them air and water tight" "How about the dock," I asked "Of course that is the biggest and hardest job," he said, and went on to explain about as follows The upper structure of the dock sides had been the chief site of the injury when struck by the hurricane and repairs there would be largely a question of usual outdoor work. The matter of making the floor air and water tight was a serious one, only to be determined after the side walls had been put in working order. since the whole of the lifting power of the dock would be required to raise it to the surface He was confident that by employing compressed air in large volumes and by the use of trained divers the work could be done.

After due inquiries the money was provided Then I saw no more of my friend, the engineer, for some months although I heard from time to time that the work was progressing well The steamship had been raised, repaired and sold at a good price The smaller vessels had also been made sound, raised, and been taken about their business leaving the floating dock still in the contractors' hands

I recollect reading in the news of the day that the dock also had been *raised* but I knew no details until I came across a foreman who had been employed on the job and had been on the dock when it was brought to the surface fully repaired, and put in service He told me that as the dock had to be lifted by its own buoyancy it was necessary that the water should be kept out until the operation was completed He had been told that in so big a structure it was probable that water would enter in more or less volume and he *must be prepared to feel it rising to waist deep before* he was let out, he told me that he sat and then stood as the water rose, first waist high, and that did not trouble him; but then it rose to his armpits, and at last to his neck, and he was giving up hope, when outdoor sounds reached him, the lifting ceased, and he was let out of his great cage

That ends my story I think—though I am not an engineer—that it is interesting testimony, though *forty-six years old, of a big project carried through* by the buoyancy from compressed air, as first developed in 1844 WALLIS NASH

Nashville, Oregon

Prize for Non-Slip Shoe for Horses

To the Editor of the SCIENTIFIC AMERICAN

I think many of the inventive geniuses among the vast army of American and Canadian readers of the SCIENTIFIC AMERICAN will be *interested to know that a* prize of $500 is offered through the American Humane Association of Albany, N Y, for the most satisfactory horseshoe or device which will prevent horses from slipping on roadways and wherever in service

Snow and ice increase slipperiness of the pavement All over the northern part of the United States and in Canada thousands of horses slip and strain themselves Sometimes they fall and injure themselves; sometimes legs are broken and they have to be shot

The inhumanity of present conditions is very great To relieve these conditions and to prevent the distressing suffering of horses, particularly on asphalt and wood block pavements, the above named association invites the cooperation of all inventors and lovers of man's most useful friend in harness

The prize will be awarded on July 1st next to the successful inventor or other person who solves the problem GEORGE FOSTER HOWELL

New York

The Gyroscopic Steering Gage

To the Editor of the SCIENTIFIC AMERICAN

Your readers may be interested to know that the use of the "double liberty" gyroscope, described so well by Dr Alfred Gradenwitz in the December 4th issue of the SCIENTIFIC AMERICAN was not confined to German airplanes I developed independently an instrument based upon the same principle, and called an "airplane turn indicator" for the United States Gov*ernment This instrument had been subjected* to rigid tests, and was just being put into service when the close of the war stopped its further development A gyroscopic turn-indicator of similar construction was also being tried out at this time in England

St Louis, Mo ARTHUR H COMPTON

Balloons and Air Currents

To the Editor of the SCIENTIFIC AMERICAN

In the article on air currents in the vicinity of clouds, it seems that a few incorrect inferences have been drawn First, the effect of heat or cold on the outside of a balloon would not be transmitted to the interior very rapidly, gases being poor conductors Consequently the displacement of the balloon would not be altered appreciably in a short time Secondly, the change of specific gravity of the air due to heating and cooling above and below clouds is not great A barometer placed over a large body of water, where the heat radiation on a hot day is intense, does not show a great fall in pressure

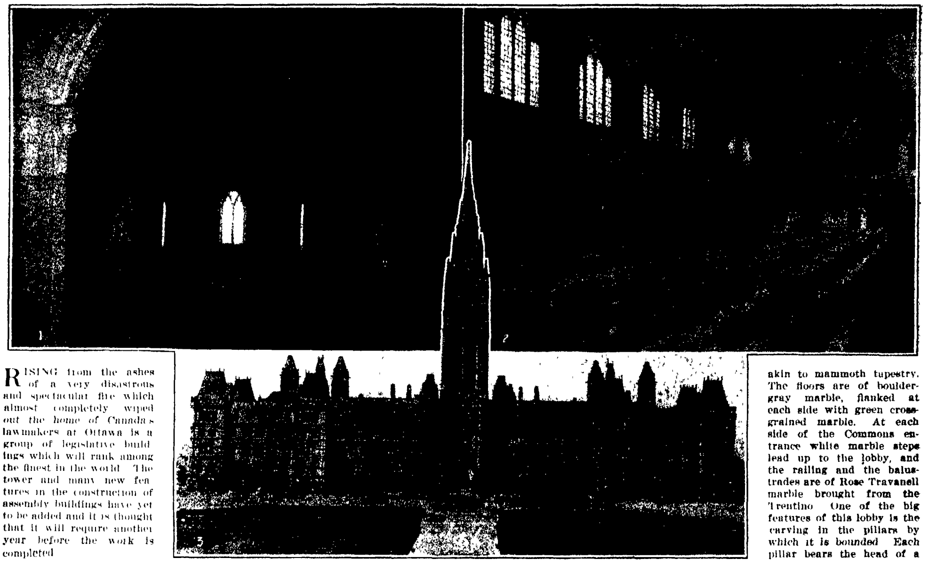
The effects noted in the article are correct, but due to different causes Below the clouds the air being cooler, moves downward and hence tends to check the rise of a balloon Above the clouds, the air being warmer, rises and checks the descent of the balloon The loss of specific gravity which would tend to make the balloon or airplane descend is more than offset by the upward current produced W G. LANDON

Amherst, Mass.

Canada's New Parliament Buildings

Some of the Architectural Features of Ottawa's Legislative Halls, Now Under Construction

By J. H. Armstrong



1 A portion of the Commons corridor, looking from the main door Gargoyles of Sir Wilfred Laurier and Sir Robert Borden appear at the right and left of the arch 2 Side view of the legislative chamber of the House of Commons 3 General view of the entire block as it will appear when finished

The new group that is replacing the Canadian Houses of Parliament destroyed by fire in 1916

RISING from the ashes of a very disastrous and spectacular fire which almost completely wiped out the home of Canada's lawmakers at Ottawa is a group of legislative buildings which will rank among the finest in the world The tower and many new features in the construction of assembly buildings have yet to be added and it is thought that it will require another year before the work is completed

The old buildings were destroyed on February 3, 1916, and six people lost their lives Shortly after resuming the session after dinner, fire was detected in one of the wings and the flames spread with startling rapidity There was a large attendance of members and the general public, and despite all efforts of those who had knowledge of the occurrence, panic followed the announcement of 'fire' and many persons were injured in addition to the number killed or burned to death Many individual acts of heroism were performed by the members and it was due to their courage and presence of mind that many more lives were not lost The library was the only portion of the buildings that emerged unscathed from the conflagration

The foundation stone of the old set of buildings which was laid by King Edward the Seventh, when Prince of Wales on September 1, 1860 was rescued from the débris and relaid by His Royal Highness the Duke of Connaught on September 1, 1916 On September 1, 1919 the foundation stone of the tower, dedicated to "Victory" and 'Peace was laid by His Royal Highness Albert Edward, Prince of Wales This stone which rises in the center of the court into a pillar with fan-shaped top forming the vaulted ceiling, represents the motherland in isolation, while at the base of the pillar the sculptor shows the waters of the North Sea leaving the shores of Britain and reaching out across the Atlantic to Canada

As it stands today the edifice is a triumph for the architectural art The exterior is of Nepean sandstone, obtained in the vicinity of Ottawa, and the tracery and cut stone work are wrought of Ohio freestone The main entrance is through the Central Tower which is at present incomplete The interior of the Commons corridor is lined with Tindall limestone, obtained from the quarries at Selkirk, near Winnipeg, and the stone so delicately freckled is wondrously rich in appearance and clothes the building like something akin to mammoth tapestry. The floors are of boulder-gray marble, flanked at each side with green cross-grained marble. At each side of the Commons entrance white marble steps lead up to the lobby, and the railing and the balustrades are of Rose Travanell marble brought from the Trentino One of the big features of this lobby is the carving in the pillars by which it is bounded Each pillar bears the head of a former Prime Minister of the Dominion Quite unique is the ceiling in this section with its octagon-shaped lozenges of reinforced concrete hanging from slender rods something like forty feet above the gray marble floor The frames are filled with paintings representing the various portfolios of the Government.

Entering the Commons Chamber one is confronted with the Gothic screen Wrought iron grills of halberts, guardant and reguardant, with crowns of the same metal and hand hammered, protect the cathedral-like windows which flank the opening. Either side of the chamber is flanked by four steps of the members' desks, the floor being of colored rubber tiling, and down the center leading to the Speaker's chair is a wide strip of teakwood flooring, the spaces between the boards being laid with ebony. One is impressed with the spaciousness, loftiness and the care with which the seating accommodation has been arranged The ceiling, like the Senate chamber, is 65 feet high and is of a pastel green in shade with panels painted in semi-conventional style. Almost $10,000 worth of 22 carat gold leaf is used in the ceiling decoration

Passing through the government and opposition benches the sight-seer comes out on the north corridor which runs east and west for 475 feet and traveling west along the barrel vaulted south corridor brings one to the main central entrance

(*Continued on page 238*)

Part of the power and water tunnel, looking from the new Parliament building toward the power house

How Strong Is the Concrete?

MANY of the engineers who were formerly employed in the building of the Panama Canal are now engaged in building the canal which is destined to connect the Mississippi River with Lake Pontchartrain, just below the city of New Orleans. This canal will cut down the distance from the Gulf to the city, aiding in the fulfilling of the city's boast, "New Orleans—The Gateway to the Panama Canal "

Novel rough-and-ready scheme for testing concrete strength with the aid of a tank of water of adjustable weight

Many novel engineering devices have been produced by the men in charge of the project, all of which are designed to aid them in bringing about the speedy termination of their tremendous task

Here we show a crude-looking, though most effective and satisfactory, machine for testing the strain concrete will stand without breaking and the strain necessary to break it.

The framework is made of very heavy timbers, bolted together in the manner shown Two ledges or shelves are supplied for the resting of the concrete to be tested The concrete bar in the photograph, which has been broken, is supported on the shelves At one end of the supporting frame the strain lever is pivoted by means of a heavy bolt This strain lever is made of a joist measuring thirteen feet in length and eight by eight inches in thickness and is fitted at the test point with a wedge-shaped pressure point

At the end opposite the pivot a huge water tank has been provided with exhausts on the bottom This tank is graduated and various heights of the water indicate the weight of the tank, filled to any level

The method of testing the concrete is plainly shown in the photo. The concrete, having been placed on the supporting shelves, the strain lever is lowered until the pressure point comes in contact with the concrete bar The amount of water in the tank is not, at that time, great enough to break the bar and additional weight is then provided by means of a hose

After the bar has been broken, the strain lever is again raised by means of the block and jack system indicated in the photo

By the use of this machine it is possible to test the strength of concrete up to more than a foot in diameter.—By *Arthur H. Lynch.*

The Electric Mule for France's Canals

VARIOUS methods have been proposed for handling canal traffic by mechanical means, and some of these have already come into use to a limited extent. The problem of canal traction is especially under consideration in France, where it is desired to increase the transportation facilities The little tractors of the Otis-Pifre electric system which we illustrate now appear to solve the problem, for the towpath does not need to be touched, and the tractors being light and cheap can be used with individual canal boats, which is now claimed to be the best method, as against towing a long train of boats. On the new system designed by Engineer Derung, two stationary cables suitably spaced apart are installed along the towpath on the side next the canal, and the tractor is made to run along these cables for the whole length of the towpath and in a practically continuous manner from one end of the canal section to the other The rear end of the tractor is connected to one or more canal boats by a hauling cable. As will be noticed in our photograph, the small electric tractor has the general shape of a light tricycle of narrow build, and in fact it is not more than 2 feet wide An electric motor furnishes the power, but precisely what characterizes the present method is that the tractive force is not exerted by the running wheels upon the surface of the roadway, but the electric motor is employed to drive pairs of pulleys which grasp the cable and thus act to pull the tractor along, and with it the canal boat Special means are provided to prevent any slipping of the cable, and one method consists in the use of a steel band having small projections all along the under side which work together with the pulleys of the tractor. The entire outfit is calculated to draw a loaded canal boat of the usual size at the rate of 2 miles an hour, but even two boats can be towed One feature is the patented device in the shape of a long arm which is mounted on the tractor and extends in the forward direction, its use being to cause the side pull due to the towing cable to act upon one of the stretched steel cables termed secondary cable, and the whole device is so designed that the mechanical component representing the side pull is entirely taken up by the steel cable.

Electric tractor now in use on the French canals in connection with a stationary traction cable

Current is brought to the motor of the tractor by the usual traveling or hanging trolley which runs along an overhead line and is connected to the tractor by a slack cable. In this way the tractor runs along the road quite in an independent manner without any person to mount or accompany it, being connected to the canal boat by a special towing cable This cable contains at the same time a certain number of electric wires, for it is found quite an advantage to use electric switches on the tractor which can be controlled by the operator on the boat without requiring a man on shore In usual operation, the whole outfit runs along from one end of the course to the other and without any disconnecting of the tractor from the canal boat But it is a very easy matter to uncouple the cable whenever it may become necessary as in the case of repairs, accidents or the like

Our cover illustration shows one of the Otis-Pifre electric tractors or "electric mules" at work on a typical French waterway, hauling a canal boat along without attention of any kind, to the amazement of the French peasant trudging by with his load of fagots This matter of electric traction is being widely discussed in France at present, where the canals are destined to play a large rôle in the commerce of the Republic under normal conditions —By *F P Mann*

Freezing Fish a New Way

A FISH FREEZING factory with a capacity of 144 tons a day is now operating in Los Angeles supplying local markets and shipping to distant ports It employs an "instant process" absolutely new in America, the invention of Nicholi Dahl, a Norwegian

Three years ago Mr Dahl, observing the Eskimos' method, centuries old, of hanging their freshly caught fish in icy ocean water to preserve them until wanted, conceived the idea of producing the same conditions artificially The accompanying view gives some idea of the simple machinery necessary Through the tubes there is a constant rush of zero temperatured brine pouring over the trays of fish placed in the trays beneath This brine is kept in motion, and in an hour's time the freezing of a six-ton supply is complete Each fish is perfectly preserved and merely awaits the cook's pleasure

Nor does broiling or frying render it mushy as it did when under the old process which took two or three days, freezing so gradually as to "squeeze out" the taste and much of the food value These come to the table exactly as fresh fish though transported across the continent

Shipments made from Los Angeles to Boston, Galveston and South American ports arrived in perfect condition *without icing* This factory, although the first in the United States and in operation but a short while, is already sending quantities of barracuda, sole, mackerel, halibut and other choice Pacific fish to distant markets

"We came to this coast," says the president of the company "because, commercially, the Atlantic seaboard is nearly fished out in comparison to the untouched millions of tons in the Pacific The world needs this food, the only question is that of conservation and distribution But between this vast storehouse and the centers of population lie the hot deserts and prairie, so a method of preservation, quick, sure and lasting, must be had for this rapidly deteriorating sea food That we have in the Dahl invention His plant, the only one until this, operates in Trondjhan, Norway, and this machinery is of his patenting Improvements in details may be made, but the freezing is perfect "

The apparatus for freezing fish in running brine. Each fish is perfectly preserved, ready for a long journey to the consumer

The Romance of Invention—XX

Thomas Alva Edison—the Man Whose Name Stands for American Invention

By C. H. Claudy

THE name of Edison is, of course, a household word, and most of us know the outlines of his life That his career constitutes a chapter in the Romance of Invention, and one of paramount interest, is obvious. Indeed, many of our readers have doubtless wondered why we did not set it as the opening chapter in this series. The reason now stands revealed — we were saving it for the closing chapter, for a fitting climax to the story that Mr. Claudy has been telling under this title So appearing, it is worth noting that the story of Edison comes at a moment when the inventor has just been celebrating his 74th birthday.—THE EDITOR.

IT would be idle to attempt to review, in the space of a magazine article, the activities of the man who is unquestionably the best known of all living inventors He would be the first to say that other men have invented things as great, as useful, as unusual, as he has ever invented—the first to give credit to the other great scientists and inventors who have brought forth from their brains, ideas, and from their lives, devotion to those ideas, which have resulted in achievements of use to mankind

But with all the galaxy of brilliant scientists and inventors spread out across a page, it is nevertheless true that the name of Thomas Alva Edison shines forth most brilliantly, for none of those who have preceded him or been his contemporaries has delved in more uncharted seas than has he or brought to light so great a variety of devices

It was the writer's good fortune to get an opportunity to listen to Mr Edison at a moment when he had not too much else running through a very busy mind, to give heed to questions In the library at Orange, which is also Mr Edison's office (and sometimes a bedroom, as the much newspaper-storied cot in a corner proved!) the head of the great Edison industries was bending, smiling, over a small paper packet As he shook hands he drew me over to look at it "Most unusual collection of industrial diamonds," he said, "look at the colors We don't get colors like that often Curious thing, the diamond—two hundred times harder than any known substance and no artificial substitute in sight It's a good thing there are enough of them, or I should have to go out of business"

This, of course, referred to the fact that the Edison phonograph uses more industrial diamonds than any other industry in the world, and that the inventor has found nothing which can be used to run in the groove of his records which will take the place of the bit of carbon that nature has crystallized

This seemed a promising "lead" so I plunged in with the question, "Do you think of the phonograph as your greatest contribution to the world?"

"Depends on how you mean 'greatest'" responded Mr Edison "As a matter of pleasure I suppose the phonograph has given a greater amount than anything I ever did But industrially, of course, my work in electric light and power was of greater importance"

"How about the motion picture?"

"Oh, well, I am not actively interested in that any more I never am interested in a thing when it gets to the point where it is a complete success I want to leave it then and go on to something else"

"Except in the case of the phonograph," put in one of Mr Edison's assistants

"Of course, except in the case of the phonograph That's because, I suppose I happen to love music Oh, I don't expect ever to get through with the phonograph It's not perfect But it is so perfect that I can't tell, and you can't tell, the difference between the original source and the recreation of that sound with my instrument It has been proved time and again, with hundreds of different critics and auditors, you cannot tell when a singer leaves off and the phonograph begins or when the phonograph stops and the singer takes up the song At the same time, the records are not perfect yet, but we get a little closer to perfection all the time, and we never stop working on them"

Inasmuch as the Edison methods of making records and reproducing copies of them, and of making the apparatus for the recreation of sound, are guarded as carefully as ever the government guarded a secret process of munition making, there was no opportunity for me to see the marvels of imprisoning sound in tiny cuts in wax, but there is no secret about seeing the great plant which rose, phoenix-like, from the ashes of the disastrous Edison fire a few years ago, and in which the mechanism of the phonograph is made It is much as is any other large factory in which quantity production has been accomplished, with the outstanding feature of having as much automatic machinery as is possible and in some cases automatic machinery one would swear was impossible until one saw it work

Not infrequently one hears the question, "What is Edison doing in his big plant at Orange?"

The answer is "making phonographs and storage batteries, and phonograph records" This is the answer as far as the public is concerned What Mr Edison himself is doing, what wonder he is working at in his own laboratory, what particular thing he has in mind to improve or change or produce next, he does not say He has long passed the point where it is necessary for him to prophesy

A very large part of his plant is devoted to the making of the Edison storage battery Inasmuch as the greatest contact of the public with storage batteries in general is in their use in lighting and starting ordinary automobiles, and because the Edison battery is not suitable for this purpose, the general public knows comparatively little of it. Yet it was as revolutionary, when produced, as anything which ever came from the Edison laboratories, and the huge factory, big as it is, cannot now keep up with the demand for these alkaline cells, which are extensively employed on commercial trucks, for lighting of railway trains, and for other purposes.

The Edison battery is made of steel. It has no acid within it. It can be broken by jar or blow but with such difficulty that it is practically indestructible It never wears out—at least, none has ever yet worn out It can stand an indefinite period without injury, whether fully charged, half-charged or discharged. It cannot be injured by overcharge or overdischarge. It is far lighter than lead-acid cells and costs less than other types over long periods of time

All this is possible because, using alkali, steel instead of lead and rubber can be employed, and because it has a completely reversible chemical cycle Charles P. Steinmetz says of it, "The characteristic feature of the Edison battery, which appears to me as the main advantage, is the complete reversibility of the chemical reactions which occur in it. With these materials—iron, nickel, and their oxides, in caustic potash as electrolyte—no chemical processes can occur which are not electrolytically reversible From that then would follow that there could theoretically be no deterioration of the battery, that is, no decrease of capacity from use or abuse

"In this respect the Edison battery appears to me essentially different from the lead battery, in which we know that there is an irreversible chemical process, the formation of lead sulfate, which means that if you discharge a lead battery you can never charge it again to the same capacity, but every successive charge and discharge reduces the capacity, be it ever so little Therefrom it follows that the life of the lead battery must be limited, that its capacity must gradually decrease until at least one set of plates has to be replaced

"It cannot be seen how an irreversible process could occur in the Edison battery All these remarkable features—that you can overcharge it or overdischarge it, can stop it and let it stand charged or discharged or partly discharged, charge it with reversed polarity, the feature that the ampere hour efficiency is 100 per cent less the electrolytic dissociation of water—are there, while astonishing to one who is familiar with the lead battery, follow as a matter of course from the complete reversibility of the chemical reaction of the Edison battery as obvious results Inversely, then, the existence of these properties is an additional proof that the chemical reaction is completely reversible; that is, that the battery does not age, has no definite life, but that its life is limited, theoretically, only by impurities finding their way into the cell."

I was interested in hearing what Mr. Edison had to say of his own battery.

"It is of enormous importance because of the shortage of gasoline," he said. "Portable power plants are necessary. Portable power plants mean portable fuel But liquid fuel from the earth is limited in quantity. Coal is unlimited, practically, we have enough for hundreds of years without considering waterfalls as a power source. With coal and water power to make electricity and an efficient means of storing that energy by a battery, we can be independent of gasoline for many purposes for which it

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Thomas Alva Edison, America's seventy-four-year-young inventor

Road Building Simplified

HARNESSING natural resources as hired men to labor and expedite the building of concrete roads has resulted in unique achievements in Sacramento County, California It so happened that a permanent highway was to be constructed along the banks of a small river The highway engineer in charge of the work immediately capitalized this natural advantage by purchasing several barges upon which he installed his concrete mixing machinery. This arrangement greatly facilitated the work. The entire equipment could easily be moved from one location to another as work on the highway progressed while the water necessary for moistening the mixture of cement, sand and crushed rock was readily pumped directly from the river, thus eliminating the need for hauling or piping water long distances Fortunately this water was not of an alkaline character objectionable for concrete purposes as are some of the natural waters of the country under discussion. This is the second time in the engineering history of the Far West that natural advantages of this type have been so utilized in road construction activities, the other case having occurred several years ago in the State of Wyoming

Jacking Up a Road

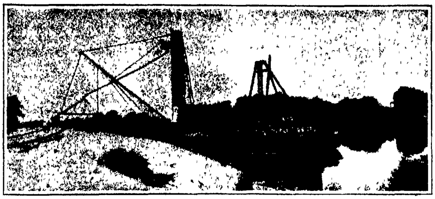
WITH as little seeming formality as one would jack up the rear wheels of an automobile for repairing nail perforated tires, a section of highway near Las Cruces, New Mexico, was saved from costly damage of a powerful washout by unusual methods The undermining influences of heavy rains deprived the sandy subgrade of its sustaining powers which in turn left the concrete slabs with but frail support The exigency for immediate action taxed the ingenuity of the engineer of the United States Bureau of Public Roads, who quickly adopted the novel procedure of jacking up the road bed and rammed wet sand into the rain-washed dug-outs as a support for the concrete slabs

The collapse of the pavement was averted, and as a tribute to the material employed and the workmanship engaged in building the highway the concrete slabs were restored to their former bed without having developed a crack or flaw Until the sandy subgrade could be rebuilt the washed shoulders of the road were protected with brush as a precaution against further erosion in the event of another gully-washing rain. The undercut gaps in the subgrade were rapidly refilled and consolidated Where the slabs had departed from the true line of their original formation, wooden stringers were inserted under them near the outer edge The concrete was elevated to its correct position by use of hand-operated jacks bearing on the stringers. Once the slabs were reinstated to the proper grade cribbing was placed under the stringers and the jacks displaced Forthwith the sand was restored as a support to the slabs, previous wetting contributing to its consolidation' The latter accomplishment was insured by use of a heavy ram, suspended from a tripod, and operated by four men.

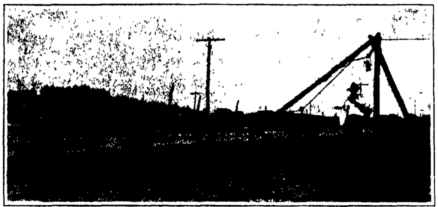
A Choice of Color in Tomatoes

DOWN in eastern Texas they grow two kinds of tomatoes for shipment—pink and green This section is not so distant from Northern markets but that tomatoes despatched in the pink stage will arrive red and in good condition for consumption. On the other hand, the shipment of tomatoes green is practical here as elsewhere The tomato is a precocious vegetable. Picked in the grass-green stage and given sufficient time, it will ripen up and acquire color.

The longer a tomato stays on the vines the better it is when it reaches the red stage In eastern Texas formerly the whole commercial acreage was handled for the shipment of fruit pink It could be left that long on the vines, and still be got north in a not over-ripe condition, and consequently it was

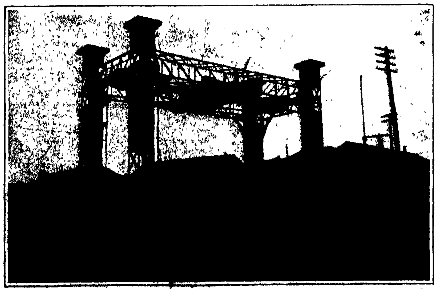


A rush-order method of road building, where the machinery for mixing and distributing the concrete is moved by boat. The gravity chute permits the rapid pouring of the concrete batch



Jacking up a concrete road in order to repair the subgrade which has been damaged by heavy rains. Hand-operated jacks bearing on stringers have been used for the purpose. The arrow indicates the ram

A pre-cast California concrete bridge which is three miles long and is a modern marvel of road building. The piers and parts forming the base of this structure were made on land



The mere pressing of a push-button operates this novel elevator bridge in the city of Manila. Electric motors at the top do the lifting, aided by counter-weights in the four uprights

That's logical enough, but it didn't prove wholly profitable enough to suit many growers A few started to ship fruit green They made money, which is the final test of any cultural method The green tomato industry developed apace There were very tangible economies of production and getting to market With green stock the vines could be allowed to run wild, in a manner of speaking, but with pink stock they must be pruned, given supports, cared for with considerable diligence There was much greater danger of frost damage with the pink The open vines which welcomed the sun and facilitated quick ripening also invited the frost

Green tomatoes go to market wrapped, in crates Pinks are shipped under refrigeration No one claims a tomato picked green ever makes better eating than one picked pink, but the acreage in eastern Texas of pink stock is dropping and the acreage of green is growing to vast proportions

Florida also ships many hundreds of cars of tomatoes picked green Research work has shown the relative importance of some of the factors affecting ripening of green tomatoes This early-picked "tom gets its color in ripening rooms, while rolling to market, and after arrival there If it is picked too green, it ripens slowly tends to wrinkle, doesn't color right, and has a bad taste and flavor Strangely enough ventilation in quarters where tomatoes are ripening is very important In a room without ventilation, acid content increased 138 per cent over vine-ripened fruit, while sugar content decreased 21 per cent

Wrapped greens also develop more acid than unwrapped, as they also are more deficient in sugar In practice, the green tomato industry determines just how far it can go in decreasing costs to advantage, and stops as near that point as possible At best, the tomato picked green never equals the vine-ripened, or even the pink, but in the race for farm profits green is the chosen tomato color down South

An Instalment Plan Bridge

A REMARKABLE illustration of the outstanding road construction activities which are making California the leading highway building state in the country is the pre-cast concrete bridge which is aiding the Golden State to solve some of her thoroughfare problems The piers and parts which form the base of this cross-water structure are made on land and, subsequently are freighted out to the point of construction where they are bedded in place on permanent foundations Once the superstructure is in place, the work of laying the roadway proper is vastly simplified and facilitated The concrete causeway presented in the accompanying illustrations is three miles long and a marvel of modern concrete construction

Manila's Push-Button Elevator Bridge

IN order to permit junks and other native craft to pass through the canal shown in the accompanying view, the city of Manila has constructed an ingenious elevator-type bridge which is operated by the mere pressing of a push-button The roadway of the bridge is raised by electric motors to a height sufficient to clear the superstructure of any native craft passing through the canal Counterweights moving in the four uprights of the bridge serve to balance the moving member, just as in the usual elevator construction

Fifteen-year-old growth of Japanese larch, after preculture

Young maritime-pine stand for which the ground was prepared by preculture

Making a Forest to Order

An European Innovation in Preparing the Soil for the Trees Which It Is to Support

By Henry Vendelmans

FORESTRY by precultures is the most remarkable innovation in modern forestry, and it has been attended with such striking success that it is being widely adopted. It can be applied practically everywhere, but it is most effective on poor land where otherwise nothing could thrive. It is based on the improvement of the soil to such an extent that it becomes suited to the varieties of trees which have been selected for planting. It not only allows good woods to be raised on land which by itself would be unable to yield any timber, but also more exacting, more valuable *varieties of trees can be produced on many kinds of* available land than would otherwise be possible.

Often, however, woods could hardly afford to be charged with the whole expense of the precultures required to make an effective improvement, and even if they could, it would probably not be wise to do so, because the outlay would be unnecessarily heavy. Therefore the precultures are generally followed up by agri*cultural crops* which sometimes leave a profit, but more often pay for the expenses incurred, or at least reduce them to such an extent that forestry is made under greatly improved conditions at a very small cost.

Planting fir seedlings with a special spade used for this purpose only

Forestry by precultures puts work on a different footing altogether from where it stood before, placing it finally within the scope of agriculture, where, after all, it really belongs. The first result of this close co-operation furthers the question of tree raising to a great extent. Its success largely depends upon the appropriate improvement of the soil, while the outlay and the financial results are greatly influenced by the yield of the crops.

When forestry and agriculture share between them the area of the estate mainly to forestry are allotted such parts of the land as would not be well suited to permanent cultivation from the point of view of the nature of the land, the climate, or the local conditions. Tree plantings are now made frequently also for the purpose of providing shelter to crops against cold or dry wind and sometimes also to suit the owner's convenience. In each of these cases returns are a consideration and as forestry is a long deferred investment, a reduced outlay is of the utmost importance. From that point of view also the method is most interesting. Even now, under favorable conditions it would allow good tree plantings of Scotch firs or other varieties to be made at a very favorable cost. In England this work has been carried out at about $5.00 to the acre, all told, which is remarkably low and is not to be compared with other methods in vogue in that country. The method consists of preparing the land, improving and appropriating it to the intended tree planting, which is then executed at the lowest possible cost. It has for its object to destroy the natural vegetation covering the land, which instead of being a hindrance, is turned to good account by adding to the humus, to break up *and aerate the soil and insure water evacuation*, to amend the soil and add to its mineral content by applying lime and chemicals; to improve further its physical condition by increasing the power for retaining water, to enrich it with available nitrogen and with bacterial flora by using green manures, to make the agricultural crop which follows the green manure pay for the expenses and to provide a most appropriate medium in which to plant at small cost with the maximum percentage of growth. Moreover, the *surface being clean* yearly seedlings are used whenever possible, and the woods are installed with the best prospects of success. In some instances sowing tree seed into the corn can also be resorted to, while in other cases untransplanted two-year-old seedlings are used to advantage.

It must be clear that close association between agriculture and forestry alone could bring about the best results.

In preparing the land it is often necessary to clear the field before plowing can be carried out. Favorable land is plowed to a depth of 8 inches; sometimes, however, it is necessary to go as deep as 14 inches, but only when either the soil is particularly hard and the subsoil unfavorable or when hardpan exists can plowing 20 inches deep be justified. In the case of hardpan within 20 inches of the surface, it is *generally* sufficient to plow 14 inches deep and to subsoil to the required depth, because either the subsequent improvements and the applied changes act sufficiently on the cement of the pan, or the roots of the trees reach that depth sufficiently in time to prevent the hardpan from being formed again to such an extent as to do any harm. When hardpan occurs at about 25-30 inches deep, it is sufficient to break it at intervals by using either the ditching plow or explosive. It is considered important to use a plow which makes wide furrows (from 14-20 inches), and turns the soil completely so as to cover and smother effectively the natural vegetation; it must also have a good clearance-space where plowbody and beam meet. For ordinary land there are several suitable plows, but in rocky land most of them are liable to get damaged; therefore a plow answering to the following description should be used. It should be light (about 140-150 lbs.), so as to be handled and put back easily into the furrow when it has been *thrown out*, but *strongly* and simply built so as to stand the strain (bolts come undone easily). Its beam should be short and double, its handles short, too. It should be provided with a swivel skeith. The share should be crested and of chilled steel. It is strong and lasts a long time, but when broken or worn out it is easily replaced. The plow should be built to cut normally at least 14 inches. Only single plows can be used. A team of two strong steady horses is more valuable in this instance than on any other occasion; a 3-horse team could easily put out of order a plow of the above description. Even where no agricultural crops are taken, when the soil is deficient in lime and it is intended to carry deciduous plantings or calcicolæ coniferous trees, from ¾ to 1¼ tons of burnt quicklime,

Breaking up the soil with ox plows for the reception of trees

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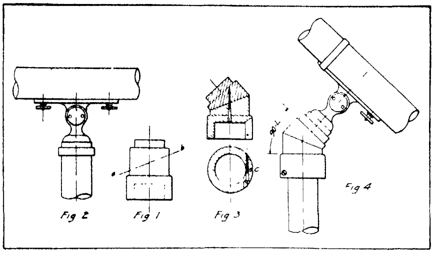
Portable Telescope with Equatorial Mounting

AS far as the present writer is aware, all of the portable telescopes that are now available are provided with tripods that support the central standard, which is adjustable as to height and permits the instrument to move around a vertical and a horizontal axis—the usual alt-azimuth mounting. To follow a star, both axes must be adjusted, and with the higher powers one is very apt to over-adjust in one direction and thus lose the star being observed

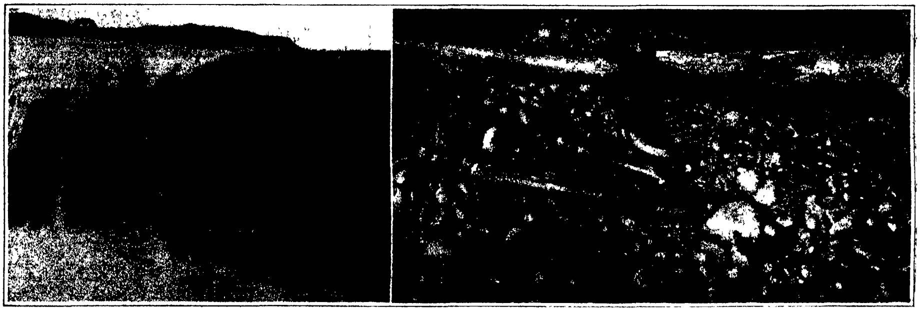
Confronted by this inconvenience the writer changed, at a trifling expense, such a telescope into one provided with an approximate equatorial mounting, and thereby made it possible readily to follow a star as long as one cared to with only one adjustment, and that, the easier of the two. The instrument was merely lined up by the marks on the cement sidewalk, but the arc generated was so nearly equatorial that it was possible to place the star well over to one side of the field and then turn the instrument over to another spectator without any danger of losing the star



Details of the home-made equatorial mounting for a portable telescope

To accomplish this, glue up several pieces of hardwood to make a block large enough to turn up to the shape indicated in Fig. 1. The base is turned out so as to fit over the central standard in Fig 2, which shows the mounting of the instrument as originally built The upper end of the block should be turned to fit tightly into the brass cap that fits over the standard. The block is then carefully sawed in two along the line *a-b*, the angle of which is equal to 45° minus half the latitude The piece removed is then turned 180° and replaced as in Fig 3, the two being joined with glue and one or more large screws A saw cut is made at *c*, and a large screw fitted in so that the block may be tightly clamped to the standard After applying a coat of weatherproof paint, clamp in place, and then fasten on the present mounting with several small screws, so that the general arrangement is as shown in Fig 4 What was originally the vertical axis is now the polar axis.

As the telescope will probably no longer be balanced, it may be necessary to tighten the pivot somewhat, and to move the point of clamping farther from the eye-piece. It so happened that with the instrument used by the writer this was accomplished by abandoning the inner screw and placing the outer screw in the hole formerly occupied by it, a small strap being used at the outer point.



Left: Entosphenis tridentatus climbing a wall at Dalles, Ore *Right:* The sea lamprey (Petromyzon marinus) building its nest in a Long Island river bottom

Two species of lampreys engaged in characteristic activities

Curious Habits of Lampreys

LAMPREYS are commonly thought to be fish and they are very generally called lamprey eels, because of their long, sinuous, snaky forms. As a matter of fact, however, they are not only not eels but they are not even true fish. They differ from the latter in several important features, the most marked of which is that they possess no jaws, but have instead extremely curious round mouths with which they are capable of exerting powerful suction Furthermore, they have no traces of limbs, and their skeletons are cartilaginous in nature A marked feature in lampreys is the seven gill openings on each side of the body, just below the eye

The mouth is a sort of rounded disk covered with rasp like teeth and having a tongue which has still stronger and sharper teeth arranged in rows like the teeth of a comb With this formidable instrument lampreys attach themselves to other fish, especially those whose bodies are comparatively soft and literally rasp away the surface to which they cling sucking the blood and swallowing the flesh of the unfortunate victim It is with this curious mouth, too, that they pick up and carry away the stones in the river bottoms where they make their nests at the time of spawning

Since lampreys are quite abundant, not only in the Atlantic and Pacific Oceans but also in lakes, rivers and brooks, it will be seen that they constitute a very serious menace to many of our food fishes A striking example of this is in the case of the common bullhead or pout This popular food fish is one of the most important fish on the market in New York, being caught by thousands in the early part of June when it is getting ready to spawn Professor Gage of Cornell University, who has made a special study of lake and brook lampreys, particularly in Lake Cayuga where they are found, tells us that he has at times seen more than 90 per cent of the catch injured by lampreys, and warns us that the attacks of this terrible parasite' are surely devastating our lakes and streams

A characteristic feature in the life of lampreys is the curious metamorphosis which they undergo When the young first come from the egg they are slender and eyeless, and their mouths are narrow

(*Continued on page 240*)

A Novel Equal-Area Projection of the Sphere

A PROJECTION of the whole sphere on an equivalent or equal area system devised by Aitoff, has been issued by the United States Coast and Geodetic Survey, size 11 inches by 22 inches at the price of 15 cents

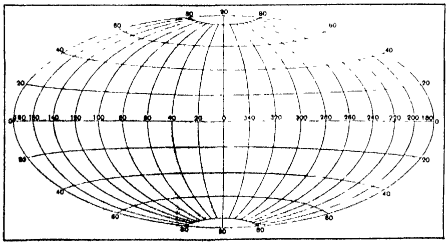
The sphere is represented within an ellipse with major axis twice the minor axis No shoreline has been included since it is intended primarily for the plotting of the stars in astronomical work, its value for this kind of work being suggested by Professor Benjamin Boss of the Dudley Observatory, Albany, N Y

The projection is bounded by an ellipse similar to that which is used in Mollweide's equal area projection but since the parallels are curved lines, the distortion in the polar regions is less in evidence The network of meridians and parallels is obtained by the orthogonal or perpendicular projection of a Lambert meridional equal area hemisphere upon a plane making an angle of 60° to the plane of the original

The fact that it is an equivalent or equal area projection combined with the fact that the celestial sphere is represented in one continuous map, will show at a glance the relative frequency of stars in the different regions of the expanse of the heavens As constructed the radius of the sphere to be projected is taken as a decimeter so that the graticule has a very convenient size for general use

As used for a map of the world this projection is well adapted to replace the Mercator projection in atlases of physical geography or for statistical purposes and has the advantage over Mollweide's in that its representation of the shape of countries far east and west of the central meridian is not so distorted because meridians and parallels are not so oblique to one another

By employing the meridian of Greenwich as a central meridian, the continental masses can be mapped where the projection is at its best and the greater distortion transferred to the Pacific Ocean

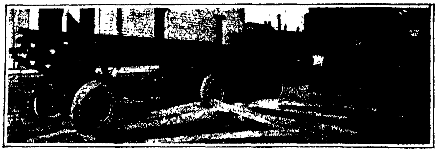


The equal-area projection of the sphere into an ellipse

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M S A E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Two-ton trucks and trailers handling casing during a freight embargo

Trucks Show Way Around Embargo

IF drilling is to continue without interruption so that leases can be held and production increased, casing *for new wells must be had, and quickly* That, in brief, is the situation that confronted officials of the Skelly Oil Company of Tulsa Okla Aggravating the situation was the knowledge that 40 carloads of casing long on order with a prominent iron and steel company, were ready for shipment at Youngstown, Ohio, but could not be moved because the freight embargo then in effect in the Youngstown district was as confining as a health officer s quarantine sign Casing in Youngstown was of discouragingly little use in Tulsa, more than 2,000 miles distant Then it was that a coincidence and faith in motor trucks combined to overcome the difficulty It was a coincidence that the Skelly Company at the moment of their need should have *had an order* with a truck manufacturer at Cleveland, Ohio, for twenty more 2 ton trucks for their fleet It was faith, however, born of satisfactory experience that led the Skelly officials to think of their trucks at this time and to believe that they could solve their problem

Consequently executives of the company began to "burn up the wires," so to speak, between Tulsa and Cleveland and they did not cease until arrangements had been made to commandeer the first three units of the Skelly fleet, then nearly ready to leave the factory When the trucks were ready the executives came on from Tulsa, bringing with them an experienced oil field driver to take charge of the trucks Other drivers *were hired in* Cleveland and the three trucks were then driven to Youngstown

There oil field experience really began Freight cars were still unobtainable in the steel city However, at Leavittsburg, exactly 25 1 miles from the steel works, a car or two at a time was to be had, which was better than none at all So, augmented by two trucks hired for the occasion, the trio of trucks set to work, hauling 6⅝ inch and 8¼ inch casing from Youngstown to a railroad siding in Leavittsburg Two round trips were made daily by the trucks and trailers, each combination hauling an average of five *tons to the load, about* 25 pieces of the 6⅝ inch casing or 15 to 18 pieces of the 8¼ size Four carloads of the 8¼ casing, weighing 32 pounds to the foot, were consigned to Breckenridge, Texas About 22 cars were loaded with 8¼ casing, weighing 28 pounds to the foot The balance of the 40 cars were loaded with the 6⅝-inch casing, weighing 20 pounds to the foot

An average of nearly two cars a day were loaded and headed for Texas, or for Tulsa, Wilson, or Beggs, Oklahoma About 88 pieces of the 8¼-inch or 100 pieces of the 6⅝ inch constituted a load for a single deck freight car, amounting to between 110 and 120 pieces of the larger size and 146 pieces of the smaller size casing for the double deck cars Three weeks of such training was real *conditioning* work for the long trip which lay ahead of the trucks The casing on its way the trucks were ready to follow suit With trailers securely boomed on as ballast the trucks set out on a 2,000 mile roll to Oklahoma, then to Texas border

Real Work for the Trailer

DURING the recent shortage of freight cars numerous manufacturing companies had to turn to the motor truck as a sure and rapid means of getting their supplies A case in point was a motor car manufacturer of Springfield, Ohio, who had considerable trouble in getting freight space, he was actually tied up for want of transportation facilities And when this manufacturer could get freight accommodations it would take just one week to bring a carload of bodies from Muncie, Ind, to Springfield

A general trucking concern of Springfield came to the rescue with motor trucks and three-ton trailers with 22-foot chassis, the trailers being fitted with special racks Our illustration shows one of the outfits loaded with 21 of the light-six touring car bodies—a load equal to that handled by a 40-foot railroad car These bodies were transported from Muncie to Springfield, a distance of approximately 100 miles The round trip was made with truck and trailer in 20 hours and this included the loading and unloading time The trailer, it will be noted, is of the automatic tracking type, permitting it to follow the trucks even around the sharpest curves

Motor truck and three-ton trailer carrying 21 automobile bodies weighing 10,500 pounds over a distance of 100 miles during railroad car shortage

Ditch Digging by Machinery

AN excellent example of the way the internal combustion engine is applied to lighten the labors of mankind is shown in the accompanying illustration, which depicts a new model excavator or ditch digger with side wheels This machine was designed to fill the demand for an excavator able to dig close to curbing, pole lines, walls, and to operate in other restricted quarters where a trench is to be dug This ditcher, with standard side clearance cutters, is designed to dig a trench 15 inches wide to a maximum depth of 4 feet By increasing the width of the side clearance cutters the machine will dig a trench to a maximum width of 24 inches The power is furnished by a heavy duty four cylinder *engine of the* water-cooled type Corduroy grip tractions are provided for supporting the rear or heavy end of the machine The engine is rated at 25 horsepower and is of the tractor type arranged for burning either gasoline, kerosene or distillate

The operating levers are placed at the back of the body of the machine and are so grouped that they may all be reached by the operator from his position on the rear platform where he can always keep one hand on the steering wheel The digging wheel is of the open type without axle and arranged *to obtain a trench of maximum* depth with a minimum diameter of wheels The hoisting drum for raising and lowering the wheel frame is mounted on the car body and connected with the jack shaft by means of a steel roller chain The steering mechanism is mounted under the frame and is operated by a worm and worm-wheel A steel belt conveyer is used for removing the material dug up and is 24 inches wide and of sufficient length to dispose of material when digging at the maximum depth The general dimensions of this ditcher are Width 10 feet 7 inches, length of car body, 18 feet, length over all, 25 feet 9 inches, height over all, 9 feet 7½ inches, weight on corduroy grip traction, 10,500 pounds

Gasoline-propelled trench digger which speeds up digging and reduces costs

Trucks Used by Sugar Growers

ONE of the latest industries to adapt the *motor* truck to its transportation demands is that of the sugar cane and sugar beet growers Sixty million tons of sugar cane or more are handled every season between the United States and Cuba. Up to now expensive and slow two-wheeled ox carts handled the bulk of this cane The same is true in the sugar beet industry where a hundred thousand American farmers grow ten million tons of sugar beets which have to be hauled *at an average of four* or five miles from the farms to the factories or beet dumps. Here again the slow and expensive horse-driven transportation *method* has been responsible for delayed deliveries and expensive labor.

Up to a short time ago, the motor truck had not been tried out by the sugar industry, but gradually after demonstrations had been held in which it was proven that the motor truck was capable of carrying more tons longer distances in a shorter period of time and at less cost, the growers realized that it was to their benefit both from an efficiency as well as an economy and net income standpoint to supplant the old-fashioned methods with the modern motor truck

Especially is this true when it has been found that by equipping motor trucks with pneumatic tires a capacity load can be hauled from the field over soft ground just as effectively as if an invisible macadamized road led up to and into the beet fields This ability on the part of the motor truck to transport sugar beets or sugar cane from the ground to the factories or beet dumps has not only decreased the time in harvesting, but has made an enormous saving in the cost of labor, permitting owners to accomplish the same amount of work in less time and with less help

Electric Vehicles in Italy

THE shortage of gasoline during the war has brought about a considerable use of electric trucking vehicles in Milan, Italy, more particularly for heavy work. Although under normal conditions gasoline will not continue at its present price of $1 a gallon, it will always be high in Italy and the cost of electricity is comparatively low The cities of the Po valley are level and the roads good. There is one electric garage in Milan which operates electric buses for all the hotels and also a regular express truck service between Milan and Bergamo. This concern is organising a corporation to manufacture and handle electric vehicles.

Reorganizing the Port of New York

(*Continued from page 224*)

and light merchandise. The defect of this system is that it is *far too limited to be a satisfactory solution of this great port problem.* A careful and unprejudiced reading of this report must convince every serious student of the problem, as it has convinced us, that as a solution of the problem presented by the obstacle of the Hudson River and the free interchange of passenger and freight traffic, the system of tunnels proposed cannot be compared with the proposed North River Bridge with its additional annual capacity for carrying 250 million passengers, from 25 to 30 million vehicles and all of the heavy freight across the river—elements of the transportation problem for which the proposed tunnel makes no provision whatsoever

From the Einstein Contest—IV

(*Continued from page 226*)

jective universe but they will disagree as to its composition in space and time separately In short, space and time are *relative* conceptions, their relativity is a necessary consequence of the relativity of motion. The paradox named at the outset is overcome, for the two observers measuring the velocity of the light produced as they passed one another, were using different units of space and time And hence emerges triumphant the *Special Principle of Relativity*, which states that the laws of nature are the same for all observers, whether they are in a state of rest or of uniform motion in a straight line

Uniform motion in a straight line is however a very special kind of motion Our experience in ordinary life is of motions that are neither uniform nor in a straight line, both speed and direction of motion are altering The moving body is then said to undergo "acceleration" which means either that its speed is increasing or diminishing, or that its direction of motion is changing, or both If we revert to our former supposition of a universe in which there is only a single body in "empty" space, we clearly cannot say whether it has acceleration any more than whether it is moving, there being no outside standard of comparison and the General Principle of Relativity asserts the invariance of the laws of nature for all states of motion of the observer In this case, however, a difference might be detected by an observer on the moving body itself It would be manifested to him as the action of a force, such for instance as we feel when a train in which we are traveling is increasing or reducing speed or when without changing speed, it is rounding a curve The force dies away as soon as the velocity becomes uniform Thus acceleration reveals itself to us under the guise of action by a force Force and acceleration go together, and we may either say that the acceleration is due to the force, or that the impression of force is due to the acceleration

Now when we are traveling with accelerated motion, we have quite a different idea of what constitutes a straight line from that which we had when at rest or in uniform motion If we are moving at uniform velocity in an airplane and drop a stone to the earth it will appear to us in the airplane to fall in a straight line downward, while to an observer on the earth it will appear to describe a parabola. This is due to the fact that the stone gathers speed as it falls It is subject to the acceleration associated with gravity Acceleration obliterates the fundamental difference between a straight and curved line. Unless we know what is the absolute motion of the stone, and the two observers, we cannot say whether the line is "really" a straight or a curved line. Since absolute motion is an illegitimate conception, it follows that there is

(*Continued on page 237*)

"Starrett saws have convinced me they are best, by test. The blade that cuts quicker and cuts longer, cuts labor costs, too."

But for a blade to cut quicker and last longer, it must be the right saw for the material to be cut. Many saws will cut more than one metal. But no saw will cut all metals equally well. The pitch of the blade, for example, varies according to the kind of material cut. Cold-rolled stock and machine steel are cut efficiently with the saw that has 10 teeth to the inch. But brass and soft metals require a fine-toothed blade. And pitch is but one of the things to be considered in selecting the right blade.

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As is shown in "Hack Saws and Their Uses," published by The L. S. Starrett Company, the characteristics of the metal which is being cut is the most important factor in determining how long it will take to cut it and, as every machinist knows, no two pieces of steel or iron are exactly alike as regards hardness, chrystalline structure, etc Therefore, no hard and fast limits regarding the cutting time of various saws nor their life can be given nor can it be said with certainty, just how long it will or should take to cut any given piece of material We can, however, take the average of as many cuts of each class of materials as possible and say that, if such of the factors as are under the control of the operator are made to conform to the recommendations given in this treatise, this average represents approximately the time in which a certain material should be cut and, in the same manner, we can say that it is reasonable to expect that a certain blade will deliver approximately so many cuts before becoming dull

The Cost of the Saw

The cost of the saw is always small—practically negligible—as compared with the value of the time of a man to use or tend it Seldom, in fact, does the saw cost as much as an hour's ordinary wage The total difference in cost between the best and the poorest saw is so slight as to be hardly discernible when reduced to the cost per cut, or even to the cost per hour of its useful life For comparison with hourly labor cost, it is convenient to divide the cost of the saw by the hours it endures and thus get an hourly rate.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

FLYING MACHINE —J HALSTEAD 1745 Montgomery Ave Bronx, New York, N Y Among the objects of this invention is to provide a flying machine in which the power elements are devices rotable around a horizontal axis transverse to the line of flight and comprising a plurality of wings which have many of the characteristics of the wings of an airplane but which include a plurality of parallel blades pivoted along one edge and movable with respect to the general plane of the wings

FEATHERING WHEEL —A L PAULSEN and J G PORTER, 914 Macdonald Ave, Richmond Cal This invention has for its object to provide a wheel of the character specified especially adapted for flying machines, by means of which the machine may be made to ascend or descend in a nearly vertical manner, and to hover over a comparatively small area or to move forward in the manner of an airplane's flight

Pertaining to Apparel

CONVERTIBLE SCARF AND SWEATER—AMELIA BOSHIER c o Hotel Ansonia New York N Y The invention relates to a scarf arranged to permit the user to wear the garment either as a scarf or a sweater Another object is to provide a garment of the type mentioned which is very simple in construction and adapted to be folded into a small bundle when not in use for storage or transportation

NECKTIE RETAINER —C SIOMAN, Box 2411 Winnipeg Manitoba Canada An object of the invention is to provide a necktie retainer which obviates the necessity of passing a tie around a collar, but which will permit the use of an ordinary four in hand tie with a collar, such as a soft collar, the tie being quickly fastened in position and held securely A further object is to provide a retainer which does not necessitate the untying of the tie but retains the same in condition for instant attachment

SUSPENDERS W E HEDGER, c/o Box C Waupun, Wis This invention relates generally to garment supporters The object is to provide a connection between the main straps at their point of intersection permitting of relative movement without in any way impairing the efficiency of the connection Another important object is to provide suitable means for rendering the connection adjustable in order to permit of regulation at the point of intersection to conform with the body length of the wearer

Of Interest to Farmers

MARKER FOR CORN PLANTERS —F HANSON, R F D No 4 Box 36 Exira Iowa The foremost object of this invention is to provide a simple device attachable to a corn planter for marking the rows to be planted Another object is to provide a marking device for the purpose described which is light in action so as to avoid the usual objectionable drag on the horses

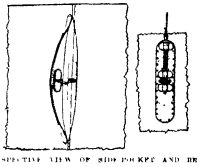
NOZZLE FOR ORCHARD HEATERS —A N COOPER, Filer Idaho The object of the invention is to provide a nozzle which may be adjusted to various positions the lower surface of the nozzle being relatively flat to permit the nozzle to rest on the ground surface and direct heat from the system associated therewith upwardly into the branches of the trees to be heated

WEEDER AND CUTTER - F F COOK, 12 Frey St, Newark N J Among the objects of the invention is to provide a hand operated device which can be easily operated by a single operator and conveniently adjusted to cut the weeds between rows of any desired width A further object is to provide a device which can be equipped with any desired number of cutting blades in accordance with the thickness of the weeds to be cut

Of General Interest

HATCH COVER AND BATTING DOWN CLAMP —J PETERSON, 206 Moravan St, Philadelphia, Pa The invention relates to hatch coverings for ships and has for an object the provision of an arrangement whereby the cover may be quickly applied and removed without injury in any kind of weather A further object is to provide a series of pivotally mounted clamps along the edges of a hatch for clamping the covering tarpauling in place.

POCKET LOCK —B LEVY, 38 E 32nd St., New York, N. Y. The particular object of this invention is to provide a lock designed for preventing pickpockets from removing the contents of a pocket A further object is to provide such a lock which may be used on trousers, coats, vests or any other garment and which will securely lock the pocket so that the contents cannot be removed until the lock is released

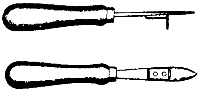

PERSPECTIVE VIEW OF SIDE POCKET AND REAR VIEW IN LOCKED POSITION

FOUNTAIN PEN INDICATOR. — A. O DAHLBERG College of Engineering, University of Wisconsin, Madison, Wis An object of the invention is to provide a device which will indicate the amount of ink contained in the fountain so that the user of the pen may know when it is running dry A further object is to provide an indicator which may be used with practically any form of pen now on the market

EXERCISING APPARATUS —J J COOPER, c o Jack Reducycle Co 58 W 47th St New York N Y Among the objects of the invention is to provide a portable exercising apparatus arranged to subject the user to the beneficial action of a vapor or Turkish bath while undergoing gentle physical exertion, such as actuating a stationary machine to simulate a bicycle Another object is to produce copious perspiration solely by the action of the vapors but while the body is in motion The heat and degree of physical exertion may be controlled by the user to suit his requirements

Hardware and Tools

CAN OPENER —A W GUILD, 2 Thane St, Dorchester, Mass This invention relates more particularly to a can opener which is both simple and strong in construction, and which by a great leverage will cut the top from a can close to the rim without leaving jagged edges An object is to provide a can opener in which the cutting stroke is upon the downward movement of the opener, and not upon the lifting stroke, thus rendering the can less liable to slip from the hands


EDGE AND SIDE VIEW OF THE OPENER

FLAT IRON —O H DESMARAIS, 26 Passaic St, Hackensack, N J Among the objects of the invention is to provide a removable handle for a flat iron of a most reliable nature and of cheap construction, which renders it impossible for a heavy iron to be dropped because of slippage breakage, or other failure of the handle or its attaching means

POCKET KNIFE —P W HALLVARSON, Black Diamond Alberta Canada The invention has reference more particularly to a pocket knife whose handle is formed from a single sheet of metal folded into parallel legs, of any desired number so that the knife blade or other instruments may be pivoted between adjacent legs, this metal handle also having controlling springs for the knife blades formed integral with the handle

Heating and Lighting

LANTERN CARRIAGE AND LENS MOUNT. —A G HAMMELL, SR, 529 W 180th St., New York, N Y An object of the invention is to provide a construction which will permit the use of a single lamp for a moving picture machine and for a stereopticon, and which will cause the lamp to be properly positioned for other purposes without an adjustment except the swinging from one position to the other along a prepared and predetermined course

Machines and Mechanical Devices

GUIDE FOR BOX MACHINES —J H OSTNER, 330 Beta Place, Glendale, L I., N. Y This invention pertains more particularly to a means for guiding the blanks from which paper boxes are formed in order that they may be properly presented to the folding mechanism regardless of the condition of said blank. It is a further object to so construct the guide that irregularities in the edge of the blank will not cause mispositioning of the blank with respect to the machine to which it is fed

COMBINED OIL CUP AND PACKING GLAND —W. F SIGLER, 2645 P St, Lincoln, Neb An object of the invention is to provide a form of combination oil cup and packing gland, which is designed for use with a mechanism provided with an upright piston rod, and which is provided with means for effectively lubricating the piston rod while also performing the function for which a packing gland is ordinarily employed.

ELEVATOR FOR FRUIT GRADERS AND OTHER PURPOSES —W P THOMAS, Carlton, N Y This invention relates to an elevator employing an endless conveyer involving a belt and slats carried thereby The elevator slats and coacting parts are so formed as to minimize the possibility of the fruit falling therefrom while being elevated, the elevator is so arranged that as a loaded slat approaches the top and starts to turn the fruit or other material falls from the slat and passes over a transverse incline to a grader and sizer

Medical Devices

MECHANICAL MASSAGING DEVICE —P C DUBE, 608 S Mary St, Escanaba Mich Among the objects of this invention is to provide a device for massaging by mechanical means a number of muscles of the body at the same time, and in a more uniformly effective manner than is possible when the massaging is done manually A further object is to provide a device that may be adjusted to massage muscles of various sizes

SURGICAL AND MEDICAL INSTRUMENT —E FUCHS, c/o E Fuchs Patent Mfg Co, Guadalajara Mexico The invention particularly refers to an instrument for electrically treating cavities of the human body An object is to provide a safe compact and inexpensive instrument which is so arranged as to receive and carry the source of stored current which is used in the instrument

Musical Devices

PIANO HAMMER — C J and W J PFRIEMER, 781 E 142nd St, Bronx, N. Y. Among the objects of this invention is to provide a device by means of which the elasticity of the felt, or its equivalent is increased, and to provide a hammer with the felt so secured and fastened as to be entirely free from direct contact with the wood or like material which may form the hammer head or molding directly connected with the piano action

Prime Movers and Their Accessories

VALVE FOR AIR COOLED SPARK PLUGS —J. J SMITH, JR, 77 W. Napier Ave, Benton Harbor, Mich Among the objects of the invention is to provide a valve which will act automatically on the intake stroke of the piston of the engine to which the spark plug is applied to permit a stream of cold air to play on the spark plug tips thereby tending to free the latter of any carbon accumulation, and keeping the spark plug cool

Railways and Their Accessories

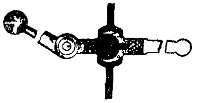
RAILWAY CAR TRUCK PEDESTAL AND JOURNAL BOX.—D W. ALDERMAN, 2256 Warren Ave., Chicago, Ill An object of the invention is to provide a journal box and pedestal having means for reducing the wearing of one upon the other to a minimum. A further object is to provide a journal box and pedestal having larger bearing surfaces contacting each other than is ordinarily provided, and is therefore stronger and more durable.

Pertaining to Recreation

FIGURE TOY.—F. A. KOCH, 269 E. 194th St., New York, N. Y. The primary object is to provide a figure toy having pliable limb members, and rigid members simulating hands and feet, and which may be capable of being stood alone and caused to assume grotesque positions in which it may be balanced.

Pertaining to Vehicles

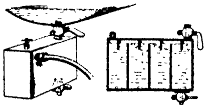
LOCK FOR GEAR SHIFT LEVERS.—O. NELSON, Box 293, Concrete, Wash. This invention relates to gear shift levers for motor vehicles, and has for its object to provide mechanism in connection with levers of this character, for preventing unauthorized use of the vehicle, when desired, by making it impossible for any one to use the lever to operate the transmission


SHOWING THE PARTS IN LOCKED POSITION

PACKAGE HOLDING ATTACHMENT FOR AUTOMOBILES —M TEICH, 1382 College Ave, Bronx, New York, N Y. This invention has for its object to provide a device which is connected to the step of the automobile, which can be secured in operative position above the step, and which can be folded and secured in position under the same A further object is to provide a casing which supports the holder when under the step, and protects the same from dirt

TRANSMISSION —J W. SANDERS, Jeffersonville, Vt The invention relates particularly to that class of transmission which is employed in motor vehicles, where it is desirable to realize on a change-speed gearing for developing a slow traction without imposing an undue strain on the motor. The principal feature consists in producing an electro-mechanism whereby the speed may be changed without throwing the clutch out, or in any other way disconnecting the engine shaft from the drive shaft

GASOLINE PURIFIER —W R HARRIS, 525 Brady Bldg, San Antonio, Texas. The object of this invention is to provide an auxiliary tank adapted to be arranged between the fuel tank and the carburator, for thoroughly removing from the fuel the impurities, such as water, dirt and the like, which tend to clog the communicating pipes This tank is divided into vertical partitions reaching nearly to the top, and webs depend from the top which tend to retard the passage of impurities from one compartment to the next.


A PERSPECTIVE VIEW AND VERTICAL SECTION

Designs

DESIGN FOR AN ARTICLE OF MANUFACTURE.—A. H. SELL, 858 S. 13th St., Newark, N. J.

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From the Einstein Contest—IV

(Continued from page 235)

no such thing as "really" straight or "really" curved These are only appearances set up as a consequence of our relative motions with respect to the bodies concerned If there were no such thing as acceleration—if the stone fell to the earth at uniform velocity—then an observer on the earth or anywhere else would agree that it fell in a straight line and straight lines would always be straight lines

Under these circumstances, Euclidean geometry would be absolutely true But if we are in a state of acceleration, then what we think are straight lines are "really" curved lines, and Euclidean geometry, based on the assumption that its lines are straight, must founder when tested by more accurate measurements And in point of fact we are in a state of acceleration for we are being acted upon by a force—namely, the force of gravitation Wherever there is matter, there is gravitation, wherever there is gravitation there is acceleration, wherever there is acceleration Euclidean geometry is inaccurate Hence in the space surrounding matter a different geometry holds the field and bodies in general move through such space in curved lines

Different parts of space are thus characterized by different geometrical properties All bodies in the universe proceed on their established courses through space and time But when they come to distorted geometrical areas their path naturally seems to us different from when they were moving through less disturbed regions They exhibit the difference by acquiring an acceleration and we explain the acceleration by alleging the existence of a force, which we call the force of gravitation But their motions can in fact be perfectly predicted if we know the geometry of the space through which they are traveling The predictions so based have in fact proved more accurate than those based on the law of gravitation

["Shinglewood" concludes his essay with a paragraph of peroration, intended to provide a dramatic and oratorical climax Both the Judges and the Einstein Editor are entirely out of sympathy with this paragraph—not with the idea of introducing such a paragraph let it be said—but merely with the execution of this particular specimen, and they are agreed that it is so distinctly out of place as to weaken the essay materially So we have taken the liberty of suppressing it Otherwise the essay is reproduced intact]

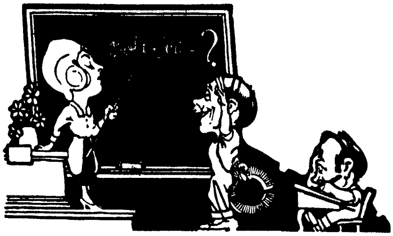
The Balky Motor

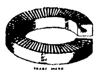
(Continued from page 227)

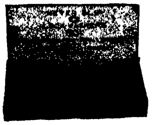
through a defective carburetor-flange packing or through leaks in the intake manifold Water or rust in the gasoline Valves sticking in their guides Dirt or poor contact in the secondary distributor The mixture much to rich. Motor too cold for fuel of low volatility Spark too far advanced

If the motor does not run well with wide open throttle when pulling or if it does not accelerate properly, look for the following Motor too cold. Low-grade gasoline Defective spark plug, especially those with the terminals at the spark gap too far apart Induction coil or condenser broken down inside If climbing long hills, the vacuum in the inlet manifold may be too low to raise gasoline to the vacuum tank in proper quantities To remedy this drop back to low gear and partly close throttle occasionally or stop the car entirely, throw out the clutch and run the engine as fast as possible with the throttle not more than half open. Water or dirt in the gasoline. Spark not sufficiently advanced.

If the motor does not run properly at high speed the following faults may be suspected: Spark not far enough advanced; spark plugs in poor condition such as badly carbonised or with exces-







what's the answer

Given a bolt and a nut—
Can you increase their efficiency?

Bolts and nuts are ancient history. Their use is as old as the metal-working industries; their applications myriad.

Can you increase their efficiency?

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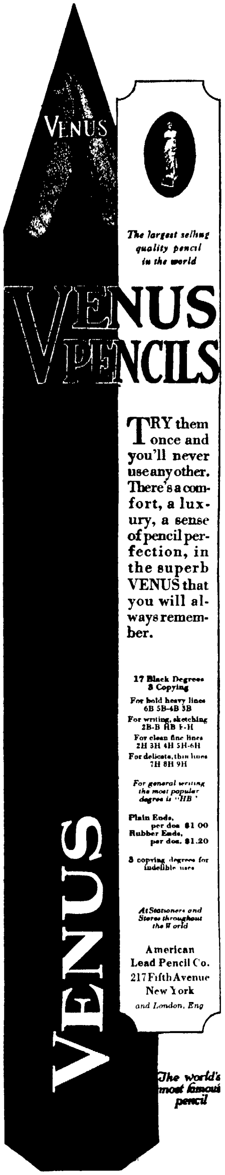

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sively large gaps Weak valve springs or valves sticking in guides. Too great a clearance between valve operating plungers and valve stems which reduces effective lift Shortage of gasoline Ignition contact breaker gap too small or too wide Pitted or burnt igniter points Muffler passages stopped up or constricted by carbon and oil deposits Leak in cylinder head gasket Dragging emergency brake

If after the motor is started it will run at high speed but will not run regularly at low or idling speed it may be because The motor may be too cold There may be an air leak which permits diluting the mixture through a porous inlet manifold gasket, through poor packing at the flange joints, or around loose inlet valve guides The valves may not be seating tightly enough or may be held clear of seat by particles of dirt Badly worn piston rings which permit gas leakage Spark gap between spark plug points too narrow Spark too far advanced or timer stuck in advanced position Gasoline leaking in through the suction connection of the vacuum tank Throttle shutter may not close properly on account of the stop screw being regulated so the butterfly valve cannot close In some forms of carburetor such as those of the compound nozzle type in which the idling jet is controlled by the throttle shutter the valve may be turned the wrong way so it does not close positively and also so it does not control the idling jet Weak or broken exhaust valve springs, which permit the exhaust valves to open under suction

If the fuel consumption is excessive it may be due to A poorly lubricated or overheating motor which does not turn over as freely as it should Dragging brakes Spark not sufficiently advanced Carburetor improperly adjusted such as having jets to give maximum power and acceleration at a sacrifice of economy Poor setting of dash control regulating air supply to the carburetor Motor clogged with carbon deposit Insufficiently inflated pneumatic tires Wheel bearings adjusted too tightly

Canada's New Parliament Buildings

(Continued from page 228)

and the central court In the distance leading to the library, a succession of intricately-carved arches stretch, the arches being upheld by columns of cyanite, and in time the niches between the arches will be filled with the marble statues of Canada's most famous men At the first floor, in this corridor of arches, is the Bridge of Sighs

A high window at the end of the central court will later be called the memorial window "In Flanders Fields" The lower third of the window will depict the Canadian soldiers wearily waiting and anxious to go into battle The second, or middle, third will show the warriors in celestial uniforms with pennants blazoning the names of battles in which Canadians played a noble part, while the top third shows the glory of Paradise and the welcome of hovering angels

Going east along the south corridor one comes to the Senate chamber where the arrangement of the desks is similar to that in the Commons, with the exception that the color is red Here the richness of the wood and carvings beggars description The ceiling is paneled in richly coffered octagons in which are painted the emblems of the five countries from which Canada derives her sons and daughters England, Ireland, Scotland, Wales and France Again the strip of teakwood and ebony leads to the throne above upon which will be placed a statue of King Alfred the Great, England's first law maker

Next comes the Governor-General's suite of rooms, separated by arches of beautifully carved oak in which doors are hung Here are to be found the armorial equipment of Canada's past Governors and above the two doors are the royal crowns of Britain with "G R" and "M R." on them, respectively. Above the third and last door three plumes signify the motto of the Prince of Wales, "Ich Dien"

In the Senate railway room are to be seen, in half circles sunk in the wall above doors and windows, paintings showing the progress of travel in Canada—the pioneer trip by water, the first train, the new steel train, the airplane, latest ship, and Canada's four leading industries—farming, fishing, mining and lumbering

Reaching the basement one sees the arteries and the nerve centers of the whole structure The floor is ten inches thick of reinforced concrete and a tunnel leads to where three-quarters of a mile away the throbbing power house generates heat for all the buildings on Parliament Hill

The Romance of Invention—XX

(Continued from page 230)

is now used The enormous increase in the use of the electric wagon, truck and pleasure car, equipped with these batteries shows the trend of the future"

It was confidently expected by a great many people that Mr Edison would produce some revolutionary device during the war which would automatically select all the German submarines from other hulls and blow them up, or extract the venom from German natures and bottle it to be used in shells against them, or some other equally remarkable and absurd idea As a matter of fact Mr Edison spent two years in Washington working day and night on war problems, and bringing to bear on military situations that resourceful mind and those perfected methods of research which the world knows by their results It was Mr Edison who made charts of submarine sinkings and plotted them by days, by hours, by ship lanes, by ports, by light houses until he had deduced some definite rules showing how and when and where a ship was safest from attack—a piece of work of hardly imaginable magnitude, and which, like Columbus's egg trick, seems perfectly obvious once it is done, but which no one but Edison apparently thought to do.

While most of the world of science and invention was devoting attention to the submarine either in endeavors to locate it before it attacked or to prevent its attack from being harmful by protecting attacked ships with nets, screens, false bottoms, water or oil or other material-filled compartments, etc, Mr Edison was engaged in what proved to be apparently the simplest as it was certainly the most original method of preventing a torpedo from doing damage

"You can hear a torpedo when it is fired and as it progresses," said Mr Edison "There is no way of muffling its sound Torpedoes, of course, are fired, not at the place the attacked ship is at the moment of firing, but at the place she will be at the time the torpedo meets her line of progress If, therefore, there was a means of preventing a ship from being where the torpedo-firing submarine calculated she would be, the torpedo would miss

"With this for a premise I calculated and experimented and devised a method by which a ship, no matter what her size and speed, can change her course to one at right angles with it, in from two-thirds to three-fourths of her length. Such vessels, so equipped, are also provided with submarine listening devices and a man or men always on duty When the sound of a fired torpedo is heard, the course changing apparatus is put into play and within a few seconds the ship is steaming at right angles

"Like most efficient devices it is simple—nothing more than huge hawsers, from which are swung very large conical sea anchors. This apparatus is connected to

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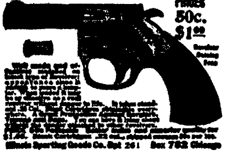

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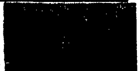

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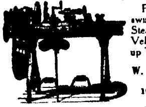

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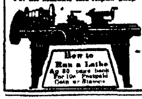

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the bow, not the stern, and when dropped overboard, simply stops the bow while allowing the stern to swing around The change of course is accomplished in a few hundred feet of water Water is a yielding medium, in the sense that objects can be dragged through it The enormous force thus exerted on the vessel is applied gently, and gradually, if quickly Many people do not realize the part played by the time element in any application of force. There is more energy in a pound of coal than there is in a pound of dynamite. But the former gives up its energy slowly, the latter, all at once If I stopped one end of a ship instantly—well, it would be like the accident to the Titanic But had the Titanic been equipped with these bow slung sea anchors, she would have had ample time to swing aside from that berg Yes, we tested the device on actual vessels and it worked as I knew it would work, but by the time this was ready for service the submarine had been pretty well attended to by other means"

It is common and usual for the newspaper and magazine writers who talk with Mr Edison to rake up back files of various papers and resurrect the story of Mr Edison's working all day, and all night and another day and night or so for good measure, and then asking for his breakfast We have been told of beefsteak dinners in the wee small hours, and the fact that Mr Edison doesn't need much, if any, sleep, and a great many more similar touches of "human interest" I can find no space for similar details here, because of the impression made upon me *by Mr Edison as a man* Mr Edison is seventy-four years of age But he is so vigorous, so alive, so interested in what he is doing that no one about him realizes it, and it is doubtful if he does himself One of his assistants said to me, "Mr Edison knows everything there is to know about the phonograph as we built it There is no detail with which he is not familiar Yet the commercial building of phonographs is no part of Mr Edison's personal work, now He spends most of his time in his laboratories"

Another said to me "When I came with Mr Edison I had heard that he 'worked' his assistants very hard It is absolutely not so Mr Edison does not 'work' anyone You 'work' yourself, because you are intensely interested in what you are doing He 'works' himself hard because he is vitally interested in what he is doing But I can't imagine Mr Edison wanting assistants about him that he had to keep at work You are either an enthusiast, working with an enthusiast, or you don't work with him"

In going through the factory and meeting and talking with many men, heads of departments, foremen, laboratory workers, workmen, I got a word here, a suggestion there, a hint somewhere else They were all to the same effect Mr Edison is "the old man" to his entire seven thousand employees It is a term of affection Mr Edison has never been too busy to be human, and never too wrapped up in inventing a new machine to forget the needs of the human machines with which he works

At the moment Mr Edison is gathering data for an investigation of the ether "I'm doing this for recreation," he told me. "I am just reading everything on the subject I can find, and finding out what the other fellow has thought and said and published and discovered I am not at all satisfied that all the present-day thought about the ether is correct If Einstein can find something new to say about space and time and geometry it may be the last word hasn't been said on the ether. But I couldn't say a word about it now. I haven't data enough I can't work without data—*all* the data"

At seventy-four, getting ready to formulate some new theory of ether *as a recreation!*

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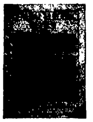

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Making a Forest to Order

(Continued from page 232)

slacked on the spot in heaps covered with earth, is spread before plowing This assists toward decay of the natural vegetation

On the flat, at first, water moves slowly sideways through the soil; moreover, as it takes some time to decompose the vegetable matter it has become a practice to leave the land alone for one season before putting in a crop, during which time the preparation of the soil is completed and chemicals are applied. The chemicals mostly used are raw phosphates or basic slag, but very often it is equally necessary to give potash. Where the soil is devoid of humus it is advisable to apply the latter shortly before sowing the green manure crop The quantity of chemicals used vary very much; they are harrowed in

For preference yellow lupins are grown as green manures whenever possible, under temperate climes, one cwt. of seed being sown to the acre It is advisable to inoculate the land with about 4 cartloads of earth from a field which has grown lupins the year before, else not infrequently the first crop fails and it becomes necessary to grow a second lupin crop which adds considerably to the cost and delays the work one year Yellow lupins stand drought well, grow quickly and yield a bulkier crop than blue lupins, moreover, they have the advantage over the latter of not being fit for food, in which case the essentials to the improvement might unwisely be taken away.

Where late frosts are to be feared sowing must not be done before May 15th, rolled and left alone until they are plowed in when fully in flower. To develop a strong lupin crop and get the full advantage of their use, more chemicals are applied than are required by the woods so that the expense incurred is higher than necessary to the ultimate object. Therefore one farm crop is generally taken without any chemicals except perhaps a little nitrate of soda. For preference a winter corn crop which can be sown early, thanks to the early readiness of the land, is taken Sometimes also a second corn crop is grown. In this case yellow lupins are broadcasted in the first corn crop about the time when ears are coming out Then the plants of lupins, which have the habit of spreading their first branches flat on the ground, will not be cut at harvest time, but will be ready to cover the field at once The lupins are plowed in before the first frosts. When a second corn crop is grown, sometimes serradella is also sown into the first crop It is sown in April and rolled. This will yield valuable green food When only one farm crop is taken no intercropping is done, but firs or spruces are planted in the corn This may be done as soon as the soil is settled, from December onward. This again is a very interesting practice: Young plants are used, they are sheltered by the crop, and one year is gained in growth and on the invasion of weeds. It is essential that plants should be small, else they would be cut at harvest time. For planting, an ordinary spade makes a slit, and the plant is fixed firmly into the soil by the pressure of the foot. The first row is planted by a string on which the distances apart are marked, the other rows are slit at sight, the outside position being paced off. This is an extremely quick process. During the planting season of December last, which corresponds to the shortest days of the year, an average of between 8,000 and 9,000 one-year-old firs were planted a day by a gang of men. An ordinary gang is composed of one slitter and two boy planters. The average above mentioned included besides planting, the lifting from the nursery, counting and bundling the plants, and covered the delay for wet weather as well. On one particular day one slitter and three boy planters put in 18,000 plants (no lifting, no rain). Last April an experienced slitter, who was recommended not to overdo it, made 1,800 slits an hour at his ease in land covered with poor grass.

Such varieties of trees as can be raised from seed and left on the spot are sometimes sown in the corn. They are simply rolled. This practice, too, saves one year.

Deciduous plants or bigger conifers are generally planted the season after the crop has been cut, but here again younger and untransplanted one- or two-year-old seedlings are being used. At the next opportunity even we shall plant into the corn deciduous seedlings for underwood, only filling the following season the plants which are to become trees. The introduction of this system will open a new era for forestry in many countries, and it is likely to be generalized as soon as its advantages are realized.

Curious Habits of Lampreys

(Continued from page 235)

and toothless. They are indeed, so strikingly different from the adult form that they were long thought to be an entirely different species, and received the distinct name of *Ammocoetes* These larvae live in burrows in sand at the bottom of the water. Those in the lakes in Central New York metamorphose, assuming the adult form, in the latter part of the fall. At this time they are about six or eight inches long, the externally segmented condition of the body disappears and the eyes appear to grow out through the skin. The mouth, which in the larva was filled with vertical membranes acting as a sieve, now changes the deadly instrument described above.

Lampreys are very particular in choosing places to spawn. They select comparatively shallow water in the bed of a stream and it is a *sine qua non* that the bottom must contain both stones and sand. Here a nest is built by the simple process of clearing the stones from a certain area of the bottom, so as to form a basin having a sandy bottom and surrounded by a rampart of stones. In the case of the lake lamprey, this basin is about the size of a common wash bowl, but in the accompanying illustration, which shows the nest made by a sea lamprey it is much larger, being 4 x 5 feet. This picture is taken from an exhibition group in the American Museum of Natural History and was prepared under the direction of Dr. L. Hussakof from studies made by him on Nissequogue River of Long Island, near Smithtown. In this stream Dr. Hussakof found numerous lamprey nests.

Our second illustration is taken from a remarkable photograph made at the picturesque Dalles of the Columbia River in Oregon. This was recently described to the writer by Dr. J. T. Nichols of the American Museum of Natural History. According to this authority lampreys are not very strong swimmers and, accordingly, make their way along the edges of rivers where the current is less strong, and where there are rocks to which they can cling when tired. In this instance instead of breasting the current of the fall, they apparently thought it was easier to climb up along the bare surface of the precipitous but not very high wall at its side. This they accomplished by a sort of wriggling motion, keeping the mouth attached to the rock and gradually working their way upward until by a final flop they were either able to land on top or else fell back to the bottom. Sometimes, too, they are said to make a series of short jumps attaching the mouth after each one.

Lampreys are wholesome food and were much prized by the Romans, especially when stewed in wine. Henry I. of England is said to have died of a surfeit of them. However, they are considered rather indigestible, and some persons find the snake-like shape repellant.—By M. Tevis.

IN THIS ISSUE:

CANADA'S SUPERPOWER ZONE
RAILROAD ACCIDENTS AND THEIR CAUSE

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

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16. MAY 1921

THE "KEARSARGE"—ONCE A BATTLESHIP, NOW A FLOATING CRANE.—[See page 249]

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March 26, 1921

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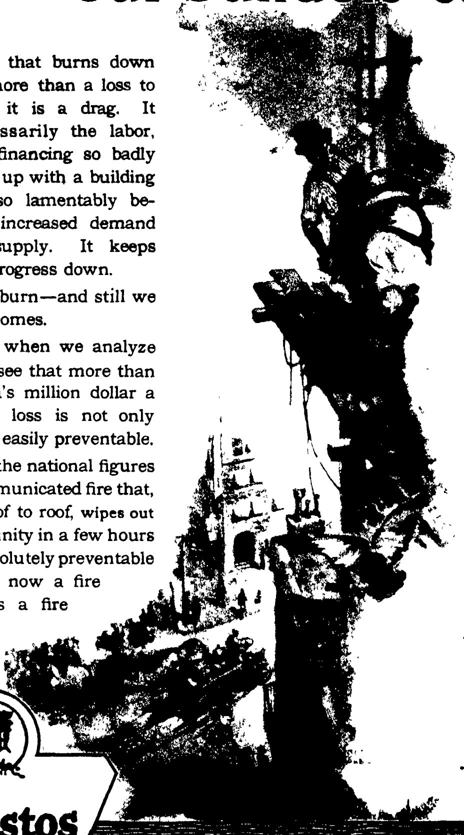
20 cents in Canada

But Fire is working faster than our builders can



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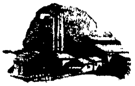

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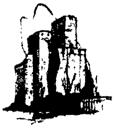
—in shingle form for dwellings.



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that cut down fire risks
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that save power waste
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that make brakes safe
FIRE PREVENTION PRODUCTS

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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

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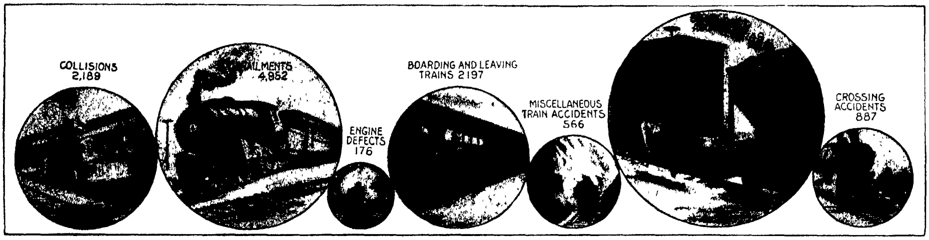


Each view is proportional to the number of accidents which it represents, not on a basis of the area of the circle in which it is framed but on one of the volume in all three dimensions of the equipment which it represents Thus the number of derailments was, roughly, eight times the number of miscellaneous accidents To make the aggregate bulk of this view eight times that of the smaller one, the diameter of the circle in which it stands is, therefore, double that of the other

Three months' railroad accidents of all degrees of gravity, classified according to causes and numbers

Railroad Accidents and How They Work

By Ralph Howard

THAT a lot of people are killed by a lot of accidents on our railroads each year is of course well known to all of us, and that some at least of this is unavoidable may be conceded It is however interesting in all ways, and surprising in some, to make a survey of the numbers, causes and results of these accidents The figures which are set forth in graphic form on this page are those of the Interstate Commerce Commission covering railroad accidents for a single quarter of 1920 These figures are presented by the Commission in considerably more detail than in our drawings, we have combined minor classifications quite freely in the effort to group railroad accidents under a few comprehensive general headings

It must be explained in the first place that we are not to feel too pessimistic over the statement that in three months we had 19,716 railroad accidents—an average of over 200 per day A British army officer, in explaining to us the catastrophically high ratio which British casualties during the war bore to the total British population, reminded us that if a man scratched his finger on a button in putting on his uniform in the field, he was requ.red, under heavy penalty, to report and undergo treatment for infection, and that this made him, statistically speaking, a casualty Doubtless there are men in the British service today who have been casualties a score of times and who bear not the slightest trace of any of these "disabilities." In quite the same way, the definition of a railroad accident is extremely broad, so that thousands of entirely trivial occurrences get thus reported with respect to trains whose passengers have not been aware of anything out of the ordinary

Nevertheless, taking the totals at their face value, we find some interesting conclusions to be drawn Nearly half the total falls under what the Commission designate as "service accidents" A casual acquaintance with the details of railroading will picture to the reader the mishaps of switching, coupling, shop work, train unloading, etc, etc, which go into this category It will be appreciated that seldom, if ever, are these accidents of direct interest to the passenger, except in the cases where they affect the departure of his train by delaying the making-up of the equipment or the arrival of the engine

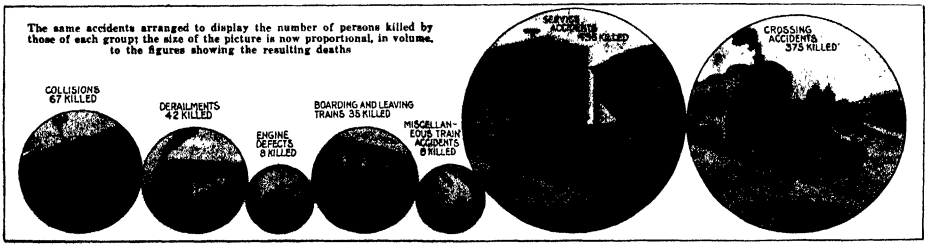
Of second and third degree of frequency are the accidents of the sort with which the passenger is best acquainted. Against 8,749 of the accidents that involve the railroad man alone, we find in the three months under consideration that there were 4,952 derailments and 2,189 collisions As a matter of fact, accidents incurred in boarding and leaving trains attained a tiny preponderance over collisions in point of numbers alone, being as 2,197 to 2,189, but in view of the usually more serious character of the collisions, and the very close equality for all practical purposes in point of numbers, we may fairly classify the collisions ahead of the others

Fifth in the order of frequency are the crossing accidents, for which ordinarily the railroad is not to blame There were 887 of these, or nearly 10 a day—which is anything but a testimonial to the automobiling public and to the liberality with which grade crossings have not been eliminated Finally, we have 176 cases of accident due to engine defects and a miscellaneous category of 566 accidents to trains, the nature of which might fairly well constitute a considerable strain upon the imagination after ruling out all the specific categories which we have listed We do not know whether an accident caused by a train's getting mixed up with a landslide would count in the Commission's reckoning as a miscellany or as a case of derailment, but it is the best approach to a miscellaneous train accident we have been able to picture so we have used it to stand for this group

If we reduce the thing to percentages, we find that of all railroad accidents large and little, during the quarter, 44 per cent were service accidents, 25 per cent were derailments 11 per cent were mishaps to persons boarding and leaving trains and the same proportion were collisions, 4½ per cent were crossing smash ups, a shade under 1 per cent were engine failures, and some 3 per cent were miscellaneous in character

If we try to distinguish the serious accidents from the trivial ones, we must give up the test of frequency and adopt that of fatality We find that here again the service accident heads the list, having taken the lives of 436 persons in three months These were in practically every case, of course, employees, since the innocent bystander who might get killed in such a mishap would be classed as a trespasser and refused a place in the record But second place in this listing

(Continued on page 257)


The same accidents arranged to display the number of persons killed by those of each group; the size of the picture is now proportional, in volume, to the figures showing the resulting deaths

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Our Attitude Toward the Port and Harbor Plan

IN view of our criticism last week of the proposed 200 million dollar, food and merchandise tunnel beneath the Hudson River, we wish to make it clear that, with the exception of the tunnel part of the problem we give our hearty endorsement to the report of the Commission. As we stated last week, the report is *comprehensive and masterly*. The proposals to build three systems of railroad belt lines, to reorganize the water fronts by doing away with the existing railroad terminals and releasing these water fronts for their legitimate use as terminals for river and ocean shipping, the deepening of the harbor channels, the provision of terminal piers and grain elevators for the Barge Canal, the reconstruction of the pier system so as to bring it thoroughly up-to-date, with wide piers, double-deck pier sheds, and an equipment of modern freight handling machinery, the provision of sufficient dry docks and repair plants, and the zoning of steamship service so that those which serve particular trade routes may be grouped together, all of these and other recommendations of the Port Commission are in every way admirable and should receive the enthusiastic support of both the City of New York and Jersey City.

What we do claim is that the one serious defect in the report is the very limited and extremely costly plan which it offers for connecting New York and New Jersey. The provision of two single tracks, costing, with the accessory yards and distributing stations, some 200 million dollars, is a plan that is at once as inadequate as it is extravagantly costly for the service that it could render. For thirty years past this Journal has been a strong advocate of a single great bridge, double-decked and of enormous capacity, as the only means of adequately connecting up Manhattan Island with the mainland on the Jersey side. If the Joint Port Authority is to be authorized to spend 200 million dollars, let that money be put into the construction of the belt lines, the reconstruction of the piers along the various water fronts, and the other improvements suggested by the Commission. Meanwhile, plans for a bridge have been prepared, the funds for its construction are available, and the whole thing can be put through contemporaneously with the belt system, pier improvements, etc., without either of the two states or the cities concerned having to contribute a single dollar from their treasuries.

It is most important to make the right start in this matter, which should have been solved several decades ago. The very first thing to be done is for the States and Municipalities to sink their local differences and realize that the reorganization of the port through which one half of the Nation's foreign trade is handled, is a question of City, State and Federal concern and should be treated accordingly. The first step toward this reorganization should be the creation of a single Port Authority.

Great Britain Adopts the One-Power Standard

GREAT BRITAIN announces that she has adopted a one-power in place of her former two-power standard. She has taken the first step to this end by scrapping those of her dreadnaughts that are armed with the 12-inch gun, eight in all. By doing so she makes yet another big reduction in her naval strength. As we showed in our issue of February 12, 1921, she lost during the war over 600,000 tons of her fighting fleet, and subsequently to the war scrapped the whole of her pre-dreadnaught fleet. The elimination of these eight ships brings her strength in battleships very close to the level of our existing battleship fleet.

This momentous change in policy was made known in Parliament by Lord Lee, First Lord of the Admiralty. In announcing the naval estimates for the next fiscal year, he said: "The Admiralty have effected drastic economies and have agreed to assume risks which in ordinary circumstances they would regard as difficult to reconcile with a full maintenance of the Government's declared policy." He stated that the economies included a reduction in the number of capital ships in full commission from twenty to sixteen, as compared with thirty-eight in 1914, this being the smallest number that would enable the essential seagoing technical training of officers and men to be carried out properly.

With regard to the smaller units; cruisers, destroyers, et cetera, the Government has decided to place in reserve one of the four destroyer flotillas of the Atlantic fleet, to withdraw completely the South American squadron, to reduce the North American and South African squadrons by one light cruiser each, and to reduce the personnel of the fleet to 121,700 men. Since this total includes the marines, it is probable that the total enlisted strength in seamen will stand at about the figure we quoted some weeks ago, say 100,000 men.

These changes, he announced, will leave a total of thirty battleships and battle-cruisers on the effective list, of which number sixteen will be in commission and fourteen in reserve. The effective fleet then will consist of twenty-two battleships and eight armored cruisers. Of the battleships, ten carry the 15-inch gun and twelve the 13.5-inch gun. Of the armored cruisers, three mount the 15-inch gun, three the 13.5-inch, and two, the "New Zealand" and "Australia," are of an obsolescent type, armed with the 12-inch gun.

Referring to the older ships, the First Lord stated that they cannot much longer be reckoned as efficient fighting ships, and hence the sum of $12,500,000 is to be devoted to replacement. This sum will not go very far in these days of high cost of construction, since it represents less than one-third of the cost of a single ship. Probably it will be expended on the preliminary work on a new type of ship, in which the experience gained with the battle-cruiser "Hood" will be embodied.

Plea for a Naval Conference

EVERY thoughtful student of the present crisis in international affairs must feel the force of the plea which the First Lord of the Admiralty has made for an amicable agreement between the United States and Great Britain on the question of naval strength. His address, which was made at a gathering of the Institution of Naval Architects on the day succeeding his announcement of the reduction of British naval strength, was devoted to the broader, international aspects of naval policy. Referring to the fact that both navies have now separately announced their intention to maintain a one-power navy, that is to say, a navy equal to that of any other, he elaborated the question in words which are so full of common sense and candor, and so admirably express the attitude of conservative opinion on both sides of the water, that we quote them in full.

Referring to the remark of Secretary Denby that the greatest calamity which could overtake humanity would be a war between Britain and America, and that between them they could control the sea, he said: "I have no doubt that between us we could, but the question before us today is whether we are heading in the right direction without consulting with each other. We have in our estimates of this year set an example of reduction. We have admittedly taken risks as regards the relative position of our navies and of others, and we are prepared to go as far as possible in that direction by mutual agreement.

"In that respect I think the Government of this country has a clear record; but merely to talk of hands across the sea is not sufficient. We must have our heads across the sea as well. . . What we want is that plain horse sense which is characteristic of both our countries, and, personally, from long knowledge of America, I have a profound belief in business talk leading up to a square deal.

"I hold strongly that in this matter we are not engaged in a game of poker or of bluff, but a sort of game where we ought to lay our cards on the table and discuss frankly with our friends what the future should be. The only point that remains to be settled is who is to make the first move to initiate the discussion. Still, we are not disposed to stand upon ceremony in this or any other matter.

"We welcome the hint which has been thrown out by President Harding and it will continue to be met with a most cordial and helpful response here. I can say this, that if an invitation comes from Washington, I am prepared personally to put aside all other business, pressing though it may be, in order to take part in a business than which there can be nothing more pressing in the affairs of this world."

The conference, here so frankly welcomed, should be held at once, and it should take place in Washington, far from the distracting atmosphere of European politics.

The Diesel-Electric Drive for Ships

FOR the first half-century of the development of the marine engine, the reciprocating engine held the field most worthily and gave magnificent service. Its first serious competitor was the steam turbine, and when once the new drive had established itself as both reliable and a saver of fuel, its progress was so rapid that for use in passenger ships it soon promised to monopolize the field.

But the steam turbine suffered under the disadvantages that the most economical speed for the turbine was the least economical for the propeller, and it was not until the mechanical-reduction gear (which in the motive power of a turbine-driven ship serves in some respects the same purpose as the transmission gear of the motor car) was introduced, that the turbine came into its own and achieved an economy superior to that of the best reciprocating engine.

When the mechanical-reduction gear made its appearance, the electrician was quick to see that reduction of the speed of rotation between the turbine and the propeller could be accomplished electrically with as much and perhaps more efficiency than it could by mechanical gearing; and so there appeared the electrical steam drive which has made such gratifying strides during the past few years. To our Navy Department goes the credit for testing out and establishing the merits of this system, which they did first in the 7,000-horsepower collier "Jupiter," and then in the 30,000-horsepower battleship "New Mexico." So well convinced is the Bureau of Steam Engineering of the Navy of the superiority of this system over any other that practically the whole of our new Navy will be equipped with this drive.

But the steam mechanical-reduction and the steam electrical-reduction drives are by no means destined to have the competition exclusively to themselves, for during the later years of the development of the steam turbine, yet another competitor has been steadily, if rather slowly, coming forward in the form of the heavy-oil, or Diesel engine. Theoretically, this is more economical than any of the foregoing, and the difficulties which have delayed its application on a more widely-extended scale have been almost purely mechanical. The development in this field has been in some respects fairly parallel to that of the early growth of the reciprocating steam engine, and particularly in respect to the steady increase in the size of the individual cylinder and the power that can be developed therefrom. Thus, nearly all of the Diesel-engine marine installations at the present time are of the reciprocating direct-drive type, with the engine and the propeller upon the same shaft, and in the larger units we have massive reciprocating engines running at a slow speed of revolution—in other words, we have a situation roughly annlogous to the marine reciprocating engine before the advent of the turbine and reduction gear.

But in the marine oil engine, as in the steam engine, there is economy in using a high speed of rotation, and hence it was inevitable that the Diesel engine interests should ultimately seek to gain for that type all the economies which were secured by the steam engine from the introduction of reduction gear, whether mechanical or electrical. That day has now come, and the results which have been gained with the first installations of this character have been so encouraging that we may confidently look for a great development in the near future of the Diesel-electric drive.

Astronomy

The American Astronomical Society will hold its next *meeting at the Van Vleck Observatory,* Wesleyan University, Middletown, Connecticut, from Aug 30 to Sept 2, 1921

Solar Eclipses.—Apropos of the annual eclipse of April 8, 1921, Dr. Crommelin writes in *Nature* that the occurrence of a central solar eclipse within the limits of the British Isles is a rare event. There has been no British total solar eclipse since 1724, and the next one will occur in 1927, if we disregard that of Jan 24, 1925, in which the track of totality merely grazes the Western Hebrides and the eclipse occurs with a very low sun The last annular eclipse before that of the present year was in 1858 and there will not be another until 2093

A Catalogue of Radial Velocities.—Many observatories have lately pushed forward the work of measuring the velocities of stars in the line of sight by the well-known *spectroscopic method, and a large collection* of data on this subject has just been published by J. Voute, of Java, under the title "First Catalogue of Radial Velocities" It gives radial velocities of more than 1,900 stars and 148 nebulae and clusters together with information concerning the observatories where the measurements were made and the magnitude, proper motion, spectrum type, and galactic latitude and longitude of each star Parallaxes are also given when known

A Large Collection of Meteor Observations. — The Leander McCormick Observatory of the University of Virginia is now publishing a work containing the results of 22,000 observations of meteors made during the years 1914-1918 by the members of the American Meteor Society This publication contains more observations of meteors discussed in a scientific manner, than any ever before issued The Society is seeking the general coöperation of astronomers in the task of securing reports of the magnitudes of telescopic meteors There has been a considerable revival of interest in meteors lately, both in this country and abroad A Committee on Meteors has been appointed by the International Astronomical Union with W F Denning as chairman Photographic methods of observing meteors are being tried in England

A Lunar Formation on the Earth.—Prof K Stoeckl, writing in *Die Himmelswelt*, describes an interesting terrestrial counterpart of the bright rays which, at full moon, may be seen extending to great distances from some of the lunar craters, especially Tycho A common explanation of these rays is that the moon while cooling, had its crust broken in numerous fissures, which were later filled up from beneath by molten material of high reflecting power The writer finds something very similar in the so called pile formation in the old mountain mass along the Bavarian Bohemian boundary, especially at Pfahl, in the Bavarian forest This formation extends in a straight line from Roding to the Bohemian border, near Klafferstrass, a distance of about 150 kilometers The white rock of the Pfahl quartz can often be found in pure form and if the earth were observed from the moon this filled fissure, wherever it appears on the surface, would doubtless be seen as a white streak on account of the high reflecting power of the white rock under a high sun

Another Comet Scare.—From time to time the columns of the newspapers are enlivened with reports that the earth is in imminent danger of collision with a comet Alarming rumors of this sort, it will be recalled, attended the last visit of Halley's comet and now it is the Pons-Winnecke comet that is about to annihilate us Sensational announcements on this subject having been erroneously credited in the press to Greenwich Observatory, Dr A. D C Crommelin of that institution takes occasion to deny them in the *Journal* of the British Astronomical Association As to the chances of collision between the nucleus of the comet and the earth, he says that the uncertainty of the comet's distance from the sun at nodal passage is quite half a million miles; the chance is, therefore, 1 in 60 that it falls within a particular 8,000 miles (the earth's diameter). Next, the comet's resolved velocity perpendicular to the ecliptic is about 8 miles per second, which would mean ⅓ hour for 8,000 miles Now, as the possible range of perihelion passage is some 400 hours, the combined chance of collision with the head is 1 in 60 x 1,200, or, say, 1 in 70,000 If we assume for the coma a diameter three times that of the earth, we should multiply the chance by 16, but it would still be only 1 in 4,000. Collision with the coma, says Dr Crommelin, would probably almost escape notice, while even if the head were encountered there is no reason to anticipate anything more than a great meteor shower.

Science

Dr. Priestley's Air Pump.—The air pump used by *Dr. Joseph Priestley, the discoverer of oxygen, has been* presented to the Franklin Institute by Mr Coleman Sellers, Jr, and Mr Horace W Sellers

The Wettest Spot.—The summit of Mount Waialeale in the Island of Kauai (Hawaiian Islands) had a rainfall of 590 inches in thirteen months The mountain is 5,080 feet high and is exposed to the prevailing trade winds

A Bathtub Census.—Boston has had a bathtub census! In 1880 there were 40.2 persons for each bathtub and in 1920 the use of tubs had increased to such an extent that there was a tub for every 4.4 persons This is certainly a victory for sanitary science even in the "Hub"

Germany Bedeviled by Occultism.—An unprecedented wave of occultism is sweeping Germany Card readers, mediums, astrologers and all the motley crew are opening up everywhere and are doing a land office business Large numbers of pseudo-scientific societies to study spiritualism, astrology and other phases of occultism are being organized

Our National Bonfire.—Fires in the United States in five years have destroyed property worth nearly $1,500,000,000 Electricity is given as the chief cause of fires, with 'matches-smoking second, defective chimneys and flues, third, stoves, furnaces, boilers and pipes, fourth, spontaneous combustion, fifth lightning, sixth, sparks on roofs, seventh, and petroleum and its products, eighth

Psychological Effect of Colors on Prisoners. — The officials of a penitentiary are trying a new experiment by repainting the four cell blocks and allowing each prisoner to select the color he likes for his own cell for psychological effect it has upon the malefactor The *corridors of the cell houses are being painted a light* brown The cells are being painted in attractive tints of yellow, blue, brown buff etc None of the cells the warden explained, is to have somber settings but are all to be bright and cheerful The penologist is always an optimist

Mustard Gas Routs Crooks. — Three bank robbers were routed by mustard gas in a Michigan bank Tubes of the gas had been placed in the bank vault a few days before as a precaution against bandits When the yeggmen blew in the doors the tubes burst and the thieves fled, leaving 85 cents of their own money and an expensive kit of burglars tools behind them It was several hours before the building could be entered with safety Only the first door of the big vault had been blown away, the escaping gas defeating the purpose of the yeggmen

Extension of the Finger-Print System to the Pores.—An important adjunct to crime detection is reported from Paris This new plan supplements the Bertillon system of measurements and finger prints It has been found that a man can be traced not by finger prints alone but by marks on any part of the body Any of the pores of the skin may be employed This is the discovery of Dr. Locard, head of the French Police School at Lyons. Criminals often use gloves to foil detectives but the forearm, or the elbow may give a print equally as valuable for identification

One Interview in 110 Years.—The Dalai Lama of Lhasa in Tibet has just given an interview to an electrical engineer This is the first time that a Lama has talked with a European in 110 years Lhasa is on a plateau, 11,000 feet high which is perhaps desirable as sanitation is non-existent Tibet seems to want telegraphic communication with the outside world and there are faint signs of an industrial awakening Mr Fairley, a telegraph engineer, had an audience with "His Holiness," who proved to be kindly and very inquisitive He also visited the Tibetan Council called the "Council of Shapes" A twenty four course luncheon followed

The Newcomen Society.—This new society has been formed in London for the study of the history of engineering and technology The prospectus emphasizes the fact that engineers, inventors and manufacturers have served the world as well if not better than generals or politicians, yet their works are almost forgotten and their names are remembered by but a few The history of engineering and technology has been, and is being, neglected, and the ambition of this new society will be to assist in supplying the deficiency A Journal is promised as well as a card index of published information Anyone interested can join, the annual dues being one pound sterling The headquarters are The Science Museum, South Kensington, London and Mr H W Dickinson is the Honorable Secretary as they term it in England.

Electricity

A Welder for the Small Job has made its appearance *in the form of a 100-pound outfit,* which is intended to accomplish any work in and around a garage, plumbing shop, machine shop, and so on The machine uses electrodes from 1/16 inch to 5/32 inch in diameter, and will operate continuously with the medium and small sizes and intermittently on the large size

A Georgian Radio Station is shortly to be erected for the purpose of communicating within a radius equivalent to the distance between Tiflis and London The new station will connect Georgia with large European centers such as Paris, London, Rome, Moscow and others Part of the same project calls for the erection of four radio telephone stations in various parts of Georgia, the central station to be located in Tiflis Georgia is in the Caucasus

Our Telegraph Industry.— According to the U S Bureau of the Census, there are twenty-one telegraph companies operating in this country with a total pole line of 241,012 miles and 1,888,793 miles of single wire More than 155,000,000 messages are transmitted each year For the convenience of customers 28,865 offices are scattered over the country A total of 39,600 employees receive salaries amounting to nearly $40,000,000 annually

Siasconset Radio Station.—A new radio station has been opened by the International Radio Telegraph Company at Siasconset, on Nantucket Island, Mass Current for operating this plant is obtained from a storage battery, which is charged when necessary by means of a gasoline driven generator set The transmitter is of the spark type, and of two-kilowatt capacity It may be operated as a quenched gap or rotary synchronous spark gap transmitter

The First Wireless Detector.—In a letter sent by Prof A Turpain of the University of Poitiers in France, the professor states that he was the first to insert a telephone in the discharge circuit from a Hertz resonator His experiments were conducted two years before Marconi began his work, and they are described in a recent issue of *Revue Generale de l'Electricite* He reports hearing the noise of the discharges in the telephone receivers although the spark was 30 yards away, with four thick walls intervening

An American Radio Record was scored by the U S Navy when the Goat Island radio station reported that messages had been sent within three minutes from Cavite, Philippine Islands, to Washington, D C, a distance of 10,000 miles The Cavite station sent test messages 7,000 miles to the Goat Island station The messages were forwarded to San Diego and thence to Washington It is said that the new automatic control, which was used *in making the record, eliminates all* handling of messages between originating and receiving points

A Compact Electrically-Driven Water Supply System has been developed by a Western manufacturer in order to afford the convenience of running water wherever electric service is available The system may draw its supply from a well, cistern, lake or stream and provides a steady pressure with but a small amount of attention A rotary pump with a capacity of 300 gallons per hour is directly connected to the motor A cast iron pressure tank acts as a reservoir and serves as a base for mounting the motor, pump and control equipment

A Condensed Heating Unit that may be inserted in the pipe outlet of any vessel for the purpose of heating water or other liquids is among the latest heating appliances This unit is inserted through the walls of the vessel below the minimum liquid level and as many units as are necessary may be used to raise the liquid to the desired temperature Each unit consists of nickel chromium wire covered with mica and enclosed in copper casings which are slipped into closely fitting copper sheaths The heater is made in different capacities from 500 to 4,500 watts

Radio Cable for Guiding Ships. — From a recent issue of *Comptes Rendus* we learn that in the summer of 1919 experiments were conducted on a large scale at Brest with the method of guiding ships through fog by means of a single pole cable carrying an alternating current of audible frequency The cable current was about 2.5 amperes, and the ships were provided with four 3 x 8 foot coils with sixty turns each and with different orientation in the ship The coils were directly connected to telephone receivers and we learn that the sound could be distinctly heard more than a mile from the cable In the American application of the radio cable a vacuum tube amplifier has been employed in conjunction with the telephone receivers as already described in our columns

The Electric Battleship

Features of the U. S. S. "Tennessee" Designed from First to Last for Electric Drive

Hydraulic cylinders which move the rudder of the "Tennessee," controlled through small oil pipes leading from the bridge and other steering stations

THE U S S "Tennessee" is the first battleship to be specifically designed for electrical propulsion The "New Mexico" though the first electrically-driven capital ship was originally intended for turbine drive and was changed over during the course of construction But the designers of the "Tennessee" had the electric system in mind from the very beginning and were therefore, able to utilize the possibilities of this drive to the fullest extent Consequently the "Tennessee" must be regarded as the type ship of our electrically propelled capital vessels, and the value of electric drive from both the military and the engineering standpoints, must be judged mainly by her performance

One of the most interesting of the features of the "Tennessee" made possible by her drive is the extreme subdivision of her interior She is literally a vast honeycomb, and her compartments are not only presumptively water tight, but actually so No means whatever have been provided for horizontal intercommunication between compartments, and if one wishes to pass from one to another, he is compelled to climb up to the gun deck and then descend again There is, therefore, no possibility of leaving bulkhead doors open nor are there weak points in the bulkheads that can be burst open by water pressure Because of this construction, it is believed that the "Tennessee" can be struck below water line perhaps repeatedly, by torpedo, mine, or shell without being put out of action. That this extensive subdivision has not been carried out in the case of the "New Mexico" is shown by the fact that the generators inboard motors, controllers, and auxiliaries are all in one room, whereas on the "Tennessee" there are separate compartments for each generator with its auxiliaries, each outboard motor, the two inboard motors, and the control station

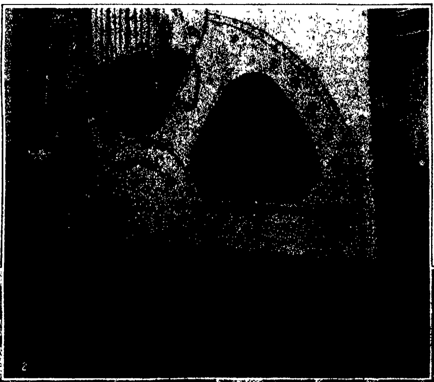
Another unique detail of the "Tennessee's" design is the concentration of the control of her propelling machinery at one point In the "New Mexico" the various controllers are scattered throughout her machinery space, but in the "Tennessee," practically all of the controls of her main generators and motors are located in a row down the center of a single narrow compartment which is placed in the most protected part of the ship The turbine-control valves and the levers for operating the generator field switches are placed in the center of the lever group, while the levers for controlling the after-generator and the port motors are on the left, and those for the forward generator and the starboard motors are on the right In front of these levers is a set of meters giving complete information in regard to the various machines concerned with propelling the ship, and behind the levers are the telegraphs and other means of communication with the bridge This concentration of control appears to be an ideal arrangement, and it should prove to be an important factor in increasing the all-around efficiency of the ship.

The "Tennessee's" main propelling machinery consists of two 15,000 kva Westinghouse turbo-generators and four 8,000-hp. propeller motors The system is similar to that of the "New Mexico," except that the current generated is 3-phase instead of 2-phase; the speed of the turbines is controlled by hydraulic instead of mechanical governors; and there are certain differences in the switching system. There will probably be considerable discussion among engineers as to the merits of these changes, but in general the equipment of the "Tennessee" can be regarded as an advance on that of the "New Mexico."

On the "Tennessee's" trial trip last fall, trouble was experienced due to the grounding of the field coils of one of the main generators This accident was purely mechanical in its nature and the damage was easily repaired, although the construction of the ship made the removal of the field difficult. The electrical performance of the ship was entirely satisfactory She is now at sea again and information concerning her performance is awaited with interest

Measuring Light Reflection

THE Bureau of Standards, in Scientific Paper No 405, has developed a simple, portable instrument for the measurement of reflection and transmission factors in absolute units A small integrating sphere, with a small segment cut off, has been adapted for attachment to a portable photometer. The opening in the sphere is placed over the surface to be tested, so that the test surface completes the surface of the sphere A small beam of light from a low voltage lamp is projected through another small hole on to the test surface at an angle of about 40° from the normal It can be rotated so that it is incident on the sphere surface at another point instead of the test surface Photometer readings are taken with these two conditions, and the reflection factor of the test surface is the numerical value of the ratio of the brightness of the sphere wall in the two cases The paper describing the instrument is now ready for distribution, and anyone interested can obtain a copy by addressing a request to the Bureau.



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1 General view of one of the two duplicate engine rooms, showing one of the 15,000 kva. generators. 2—Forward end of one of the four 8,000 horsepower Westinghouse propeller motors. 3.—The general control room, placed in the center of the hull, below the protective deck. This is the nerve center of the whole ship

The electric propelling machinery of the battleship "Tennessee"

Saving Coal by Reducing Power Costs

NOT unlike the human brain in function is the novel device recently installed in the engine room of one of New York City's largest hotels. In a manner the device is the brain of the hotel, or at any rate one of its vital nerve centers.

The contrivance is a large instrument board, on which have been assembled thirty-three measuring and recording instruments, all of which take part in intelligently regulating, from this central station, those engine room activities so essential to the comfort and safety of the hotel's twelve hundred guests. Most of these various instruments are in use separately in engine rooms, but in scattered places, the novelty of the plan lies in using instruments of the recording type to cover so many important branches of a power plant and in assembling them in one place for convenient observation and comparison

At this board there will be stationed, during every hour of the twenty-four, a watch officer, whose duty it will be to keep track of the records made by the instruments, which will show varying conditions with respect to the heating, ventilating, generating, refrigerating, water supply systems, etc, and when conditions go beyond certain limits the watch officer will notify the man in charge of that particular department, who will take the necessary action The man who has charge of the board will be able to tell not only just how things are at a particular moment (the old style instrument would tell him that much) but he will be able to tell in addition the condition of affairs during the entire watch just previous to his and will thus be able to govern himself accordingly This is made possible by the fact that each instrument has on its face a recording card on which the record is automatically set down, as it is on the well-known recording thermometer. These records will thus be available at any time to the chief engineer or to the management of the hotel and may be filed for future reference They will undoubtedly furnish valuable data for computing accurately operating costs, etc

This instrument board is expected to help not only in operating the hotel more efficiently and to the greater comfort of the guests, but will likewise prevent waste, particularly waste of coal, a most important advantage, in view of the high price and scarcity of that essential commodity For the whole matter of power, whether in the form of heat, light, steam, electricity, etc., reduces itself to the problem of the all important coal bin, and if more energy, in any of these forms, is used than is necessary to produce desired results, just that much coal is wasted For this reason the great saving of coal that this device will effect should recommend it to all hotels, office buildings, or other establishment where power, heat, light, etc, are required

This board will act as a constant check and reminder; consequently there will be no excuse for a man's overlooking to do certain things that he ought to do. For instance, supposing that, under the old system, the temperature outdoors, in the morning, is such as to require a certain pressure of steam in the heating system of the hotel to make milady comfortable The requisite pressure is turned on. Later in the day, however, the temperature outdoors rises. But the man in charge of the heating apparatus in the boiler room, having other duties to perform, may forget to keep track of the temperature outdoors. Consequently the amount of steam sent through the radiators is not reduced. As a result more heat is used than is necessary and this condition may continue for hours, unless somebody in the hotel—a guest perhaps, or an employee—complains about the excessive warmth During all this time heat, and consequently coal, has been wasted Under the new system this waste will be prevented because a glance at the instruments "temperature outside" and "temperature in building" will tell the man in charge just what needs to be done

Again, under specified conditions, exhaust steam is used for certain heating purposes and under other conditions live steam is employed The use of the latter when the former would do the work of course results in waste, which the board will prevent Once more In every engine room there is a device for 'blowing off' the boilers; that is, for ridding them of sediment As this is done only once a week there is always the possibility of the job's being overlooked, with conse-

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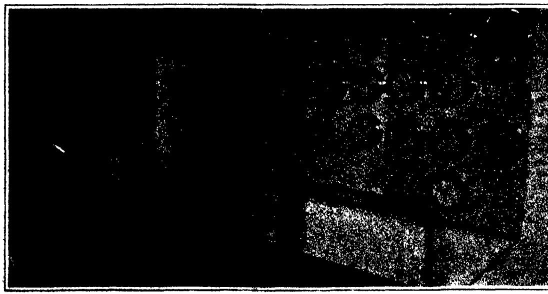
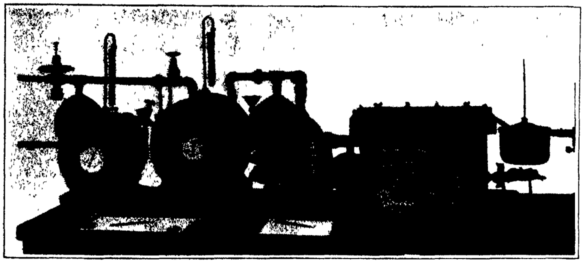


Running a hotel from a single instrument board



Bureau of Standards apparatus for testing the efficiency of gas burners

Keeping Check on Gas Burner Performance

DISTINGUISHED as the first apparatus of its sort, the U S Bureau of Standards has designed suitable equipment for testing gas burners If the laboratory arrangement—the result of 18 months' ceaseless effort — merits in practical application the claims for it in theory, a distinct contribution has been made to the study of how to increase the efficient use of gas This statement is particularly applicable to the consumption of natural gas in domestic burners

Specific tests have revealed the inability of gas appliances now in use to utilize any substantial percentage of the heat value of gas—only ten to thirty per cent The possibility of enhancing the efficiency of the equipment to the use of thirty to fifty per cent is altogether feasible—by a readjustment of gas burners and in many instances the displacement of present-day appliances A scientist of the Bureau of Standards is responsible for the statement that domestic burners leave scope for 100 per cent economy

The principle employed by the apparatus developed by the Bureau of Standards for testing gas burners is that of determining by direct measurement the percentage of primary air which is injected by the gas under any condition of operation The burner is first operated alone, the pressure being scientifically determined The cover is then placed on a box, an essential unit of the laboratory equipment, and air is forced in through a meter until the previous pressure condition is duplicated Readings of the air and gas meters reveal the relative volumes of air injected therein and gas consumed

The photograph shows a 40 cubic foot holder, into which gas is pumped, then passing through the wet meter into the burner A 'thirty-light' dry meter is used for measuring the air. To eliminate fluctuations

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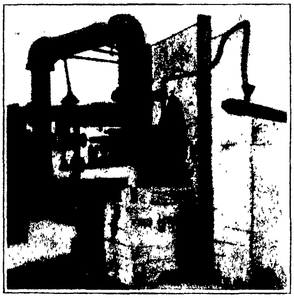

View of one end of the phosphoric-acid furnace, showing water-cooled oil-burner and slag holes

Phosphates by a New Process

A NOVEL method for producing phosphoric acid for commercial fertilizer purposes as evolved by the United States Bureau of Soils, has developed the use of crude oil as a heating agent in a special design of furnace which embodies the features of both the open hearth and the blast furnace Inasmuch as crude oil is the most economical and readily accessible of fuels in the phosphate mining areas of Florida, the government experiment has peculiar significance to the commercial fertilizer industry

Two oil burners one at either end of the furnace with an elongated hearth, play over and above the latter and through a central shaft containing the phosphate charge which is to be smelted Safeguarding the ends of the burners from melting at the temperature attained which is approximately 1,500 degrees Centigrade are water jackets fashioned similar to those employed in cooling the tuyeres used in supplying hot blast to the blast furnace

Government experts are hopeful of promising developments in the not remote future from the special type of furnace as well as the use of crude oil as a heating agent Advantages of the new method over the old sulfuric acid way are already obvious says the Bureau of Soils To illustrate, only excellent quality phosphate rock containing a maximum of 4 or 5 per cent iron and aluminum oxides are now being used by the fertilizer manufacturers in producing acid phosphate

Such a rigid requirement involves the use of an elaborate washing and screening process in assembling the rock from the phosphate beds of Florida Necessarily,

(Continued on page 258)

Canada's Superpower Zone

What Ontario Has Done in Hydroelectric Development

By Robert G. Skerrett

CANADA has set the pace for the United States in the creation of what may properly be termed a superpower zone. Physical and economic circumstances forced this upon a section of the Dominion, and we have every reason to be interested in what our neighbors to the north have achieved in overcoming natural handicaps. The subject is all the more deserving of consideration on our part because of conditions that are gradually changing within our own borders, and especially in view of the proposed institution of a superpower zone in our northeastern Atlantic States.

The Provinces of Quebec and Ontario hold more than half of the population of the entire Dominion, and within their gates five-sixths of the country's manufactures are produced. And yet, strange as it may seem, this chosen center of Canadian industry is woefully devoid of native fuel suited to the generation of abundant power and the heating of the habitations of the millions of people making their homes in that region. In Quebec there is neither coal nor mineral oil for power purposes, and Ontario can boast only small and diminishing quantities of natural gas and petroleum. True, in the northern part of the province, traces of low grade lignite have been found, but so far nothing has been disclosed that warrants the belief that there are any deposits of coal of actual commercial value.

While nature has been seemingly stingy on one hand she has been generous on the other in furnishing a substitute source of motive energy. Canada, in its entirety, has a total endowment of approximately 20,000,000 horsepower in her falling waters, and fortunately three-fifths of this aggregate of inexhaustible impulse flows through the Provinces of Ontario and Quebec—for the most part within easy reach of the present settled area. For a while, and that only a few years back, water-power developments were sporadic and wholly in the hands of private enterprises, and those that partook of a public service character were, more often than otherwise, inclined to exploit the people—charging for current out of all proportion to the cost of generation and distribution.

During this period, the main reliance of the populace was upon coal for domestic heating and the majority of industries also depended upon this fuel, most of which reached them from the United States. Then came the coal strike in Pennsylvania during the fall of 1902, and a Canadian Railway, tapping that source, showed no disposition to transport the coal already mined when the rigors of winter set in. Citizens in Toronto had to pay a hundred per cent more for their fuel, and their intense suffering was mitigated only by importing coal from Wales. That experience directed general attention to the fuel and power problem of Ontario and Quebec, and the taxpayers of Ontario were aroused to a better understanding of what water-power meant to them and how intimately they were concerned in the potential benefits of long-distance transmission of electric current.

Out of the agitation that followed, the Ontario Hydroelectric Power Commission was born in May, 1906, and modified for the better by the act of the succeeding year and by various subsequent amendments, the last of which was passed by the Canadian Parliament in 1920. The Commission is, in effect, a body corporate consisting of three commissioners, two of whom may be members, and one of whom shall be a member, of the Provincial Cabinet. Broadly the organization is a governmental one which is authorized to cooperate with municipalities and districts desiring electrical energy, and is empowered to build and to operate distributing systems, power plants, and even railways.

At the beginning, the Niagara Division of the Commission's project constituted the biggest hydroelectric distributing system then extant. Since then eleven other districts have been covered, and it is claimed that the present network of wires and the associated power plants form the greatest combination of its kind. It is certain that the undertaking has forged ahead in an impressive manner. In 1910, the Commission initiated its transmission business with the delivery of only 750 horsepower, and none of that energy was produced by it. Last year the transmitting wires distributed more than 315,000 horsepower, and by the close of 1921, when stations now building are ready, the total output for public use will amount to 750,000 horsepower—a thousandfold amplification of service in eleven years. By 1923 the aggregate production is expected to reach 1,400,000 horsepower.

The twelve active systems of distribution take care of 180 communities, ranging from cities down to villages and townships. In addition to these there are numerous municipalities that have made contracts with the Commission, and service will begin as soon as the necessary equipment can be obtained. And then there is a considerable group on the waiting list, which cannot be accommodated until the supply of current is equal to the demand. In brief, according to the reports, the actual and prospective centers of population interested in the Commission's work total more than 250.

Broadly speaking, the whole scheme is in a measure municipal ownership under Government control, with certain variations that give the Commission the right of initiative, the power of eminent domain, and authority to go ahead when the public welfare warrants. In general, when a city, town, village, or rural district wishes to participate in the benefits of the hydroelectric system, the community asks the Commission for information as to cost of local distributing lines and the needful connection with the nearest of the Government wires. The Commission's engineers examine the territory and report, and, if the terms suit the applicant, the taxpayers of the locality vote to provide the required funds. With this done, the Commission enters into a contract with the municipality. As a matter of security, the Commission then stands back of the community's obligation, and, in its turn, the province becomes the financial sponsor for the Commission. However, there is no revenue to the province other than the rentals it derives from leases of water-powers, such as those of the Niagara River, etc.

Even so, the province faces no liability in the working out of the undertaking, for the power and light users are charged sufficient not only to cover the expense of the service but to create a sinking fund which, in thirty or forty years, according to the arrangement, will leave each constituent community the owner of its plant. At the end of that time, the rates will be just high enough to take care of upkeep, repairs, and the actual cost of the electrical energy delivered. That is to say, the principle on which the Commission executes its trust is that the charges to the public shall be reduced whenever the income exceeds the surplusses required to meet the provisions of the sinking fund.

Generally stated, a steam-raised horsepower entails an outlay in Canada today from $40 to $60 annually within the territory where the Commission is able to give on an average a hydroelectric horsepower for only $18 a twelvemonth. This, so it seems, is less than half that charged in any section of the United States east of the Pacific slope. No wonder, then, that the Province of Ontario generates nearly 96 per cent of its power through the impulse of falling waters, and the Dominion at present has 276 developed horsepower for each thousand of its inhabitants—a ratio that is surpassed by only one other country, Norway. The Commission, through its widened use of electricity, has cut down the consumption of bituminous coal yearly in the Province of Ontario by something like 6,000,000 tons.

Electric power has been made available to well-nigh

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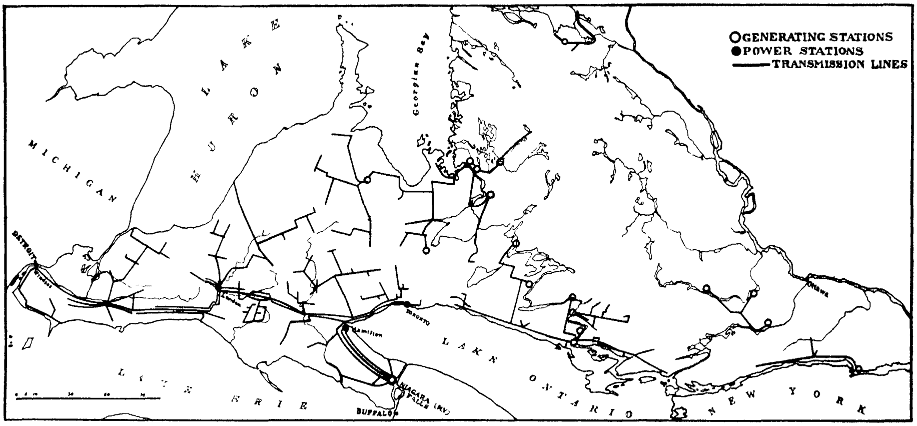


Map showing generating and distributing stations together with the transmission lines of the Ontario Hydroelectric Power Commission

Relativity and a Rotating Disk

An Application of Einstein's Theory that Has Caused Much Misunderstanding

By Leigh Page, Ph.D.

THE application of Einstein's principle of relativity to a rotating disk has proved puzzling to many readers. Therefore a close analysis of this problem may be of value in dispelling some apparent inconsistencies of the theory

First it must be emphasized that the relativity idea does not hold true of rotation in the same sense that it does of translation If two observers located in unaccelerated reference systems, such that one has a constant velocity of translation relative to the other, investigate the phenomena of nature—each relative to his own reference frame—they will arrive at identically the same laws. They will find no experimental means by which they can determine which observer is at rest and which in motion In fact they will conclude that there is no meaning to the term "absolute motion," or "absolute velocity", the only velocity which has any significance is that of the one observer relative to the other

In the case of rotation, however, the matter is quite different Consider two horizontal circular disks one above the other, one of which is rotating relative to the other around the common axis through their centers If an observer on one disk finds that his geometry is Euclidean and that he can synchronize clocks in an unambiguous manner (his disk is not in rotation), the other will find—provided he can make sufficiently accurate measurements—that his geometry is non Euclidean, and that if he synchronizes two clocks on opposite sides of his disk by a light signal guided by mirrors so as to travel along the periphery of the disk on one side of the axis, the result will be different from what would be obtained if the light signal followed a path on the other side of the axis By such purely kinematical experiments the second observer can detect his rotation In addition he could employ dynamical methods He would find—provided he was standing at some point on the disk other than its center—that a body held in his hand would exert a pull on him in a direction away from the axis which would be greater the farther away he moved from the center of the disk If he was unaware of his rotation he might attribute this force to a gravitational field, but a type of field which obeys a law differing from Newton's law of gravitation in two important respects. First, the gravitational force is directed *away* from the center, and second, the force *increases* with the distance from this center Einstein's equivalence hypothesis asserts that the observer on this disk could not tell in any way whether he is located on a rotating disk or at rest in a gravitational field of the type described Therefore space in such a gravitational field must be non-Euclidean in the same degree as on the equivalent rotating disk This illustration of the meaning of the equivalence hypothesis is made use of by Einstein himself (Relativity—Translation by R W Lawson, Henry Holt & Co., 1920, Chap 23), and has been repeated by Mr Bolton in his prize winning essay It is the non-Euclidean character of space on a rotating disk which has proved a stumbling block to some readers of Einstein's theory, and which it is proposed to examine in detail

Suppose that a number of short measuring rods identically alike are divided between the observer *A* on the rotating disk and an observer *B* who does not partake of the rotation *B* places a row of measuring rods end to end under the disk along a line extending from the center out to the edge, and a ring of rods all the way around the periphery of the disk As his rods are stationary, he will find that the number of rods on the circumference of the circle he has constructed is just 2 π times the number on the radius Now let *A* do the same, placing his rods on the disk Each rod *A* has laid along the radius will appear to *B* to have the same length as his own, but the special theory of relativity teaches us that the rods laid along the circumference—since they are moving in the direction of their length—will appear to *B* to be shorter than his stationary rods Therefore if *B* makes a count at any instant of the rods laid by *A* on the disk, he will find the number around the periphery to be *greater* than 2 π times the number along the radius As we are dealing here with a count of discrete objects, *A* will get the same results as *B* Hence *A*'s space if measurements are made in the way we have described, is non-Euclidean

Suppose though, that *A* places his rods on the disk while the disk is at rest relative to *B* Then, of course, *A* will find that he has placed 2 π times as many rods around the circumference as along the radius If now, the disk is set into rotation, carrying with it the rods placed on it, what is going to happen? Unless the relativity theory leads to a contradiction, one of three things (or a combination of them) must take place First, the rods along the radius may remain end to end in a straight line, and small gaps appear between adjacent rods along the circumference so that if the latter are pushed together additional rods will be required to complete the circuit, second, the rods along the circumference may remain end to end and it may be necessary to remove some of the rods along the radius to prevent buckling, or third, all the rods may remain end to end but the initially straight row along the radius may become curved as a result of the rotation so as to resemble one of the spokes sometimes seen on fly wheels In the first case *B* would conclude that the radius of the disk had been unaffected by setting it into rotation, whereas in the other two cases the disk would appear to him to have shrunk Which of these effects would actually occur could not be predicted without a much greater knowledge of the structure of matter than we have at present, and to settle the matter by experiment appears hopeless on account of the smallness of the effect for velocities of rotation low enough to avoid disruption of the disk Of course, centrifugal strains due to rapid rotation are supposed

(*Continued on page 259*)

Correspondence

The editors are not responsible for statements made in the correspondence column Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

Mining Coal in Germany

To the Editor of the SCIENTIFIC AMERICAN

Assuming that you desire the greatest amount of accuracy in your publication, I call your attention to page 685 of the issue of December 25, 1920

There is an illustration of the Lubecker type of excavating machine which is stated to be "Scraping off the coal in the open mines"

The writer is very familiar with this type of machine and calls attention to the fact that the machine as shown is stripping the overburden from the coal deposit after which the coal itself, in a comparatively thin vein, is mined out

You will realize of course that the description given in connection with the picture would assume a coal vein thirty feet in thickness, starting at the ground level GEO B MASSEY

Chicago, Ill

Wireless Range and Magnetic Storms

To the Editor of the SCIENTIFIC AMERICAN

In the *Radio News* for December, 1920, is an account of the receipt in Scotland by a wireless amateur, Mr George W Benzie, of wirelessly transmitted speech from the station of Mr Hugh Robinson at Keyport, New Jersey, 200 watts being used, and Mr Gernsback suggests in an editorial that "all such freak messages take place only during magnetic disturbances of the earth"

This suggestion is of interest because I had already pointed out in my paper on wireless telephony, "Transactions of American Institute of Electrical Engineers," July, 1908, that super-positions of curves of magnetic disturbances furnished me by the U. S Weather Bureau with the curves taken by me of relative intensity of transatlantic transmission showed that the curves had the same character and that therefore the two phenomena were related to each other.

Two and a half years ago I published in the SCIENTIFIC AMERICAN an account of the first transmission of speech across the Atlantic on several occasions in the spring of 1908 between Brant Rock, Mass and Macrihanish, Scotland

It would be very interesting if some one in a position to obtain access to the records of magnetic storms would ascertain if there were not strong magnetic storms in the spring of 1908 about the time this first telephonic transmissions took place

Of course, the transmissions referred to, since they were carried out with professional apparatus and towers 420 feet high and one kilowatt of energy at 17,000 cycles, are not by any means comparable as a feat with the receipt by Mr Benzie from Mr Robinson's station but it would nevertheless be a matter of scientific interest to know if the transmission on the two dates referred to occurred during magnetic storms as, if so, it would tend to confirm Mr Gernsback's theory and the relation of the curves for transatlantic transmission and magnetic disturbances referred to in my 1908 paper. REGINALD W FESSENDEN

Boston, Mass

Steam Airplane?

To the Editor of the SCIENTIFIC AMERICAN:

I note a recently published statement that eighteen aviators have lost their lives in the United States aerial mail service since May 15, 1918, and as many of these accidents were doubtless due to engine failure I write to suggest that there appears to be every reason to believe that steam engines could be successfully used on flying machines instead of internal combustion engines, and thus one great cause of accidents removed In an account of Sir Hiram S Maxim's experiments with airplanes in 1892 I find the following "He built a pair of compound engines, with cylinders of high-grade cast steel, which, together, weighed 640 pounds and, with a steam pressure of 320 pounds to the square inch, developed 362 horsepower, or one horsepower for every 1 76 pounds of weight Steam was supplied by a special water-tube, oil fired boiler, which weighed about 1,000 pounds" and besides there was "600 pounds of water in the tank and boiler" This makes a total weight of 2,240 pounds for the engine boiler and water (fuel weight not being stated), or less than 6 12 pounds per horsepower, as compared with a weight of 8 or 9 pounds per horsepower for the Wright brothers' engine of 1900, and surely much greater efficiency in the matter of weight per horsepower can be secured by making use of the modern improvements in light-weight steam engines as exemplified in the Doble and other steam automobiles As the advertisements say—"eventually why not now" use steam engines on flying machines? Then, with the advent of the helicopter (which seems quite near), with its ability to land safely anywhere and its safe controls consisting of propellers instead of inert plane surfaces, aviation will be safe.

Livermore, Cal ELMER G STILL

The Big Navy

To the Editor of the SCIENTIFIC AMERICAN

Kindly allow a word of appreciation of your articles in your issues of January 8 and January 22 on the question of disarmament I have admired your paper for many years and I am convinced that today you are rendering to humanity a great service because of the position which you take in this matter

Ft Wayne, Ind JAMES STRACHAN

"His Hair Turned White Overnight"

To the Editor of the SCIENTIFIC AMERICAN

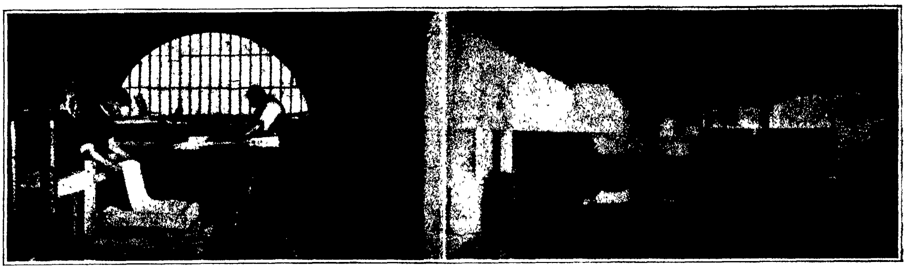
All my life I have heard persistent but not very well authenticated reports of cases in which a man's or woman's hair has turned white in a single night" The cause to which it is attributed is usually fright or worry I have never had opportunity to investigate one of these reports nor sufficient credulity to accept it without proper verification, and I should like to see a discussion of the matter in your columns

To me it seems that when a portion of a hair is well outside the skin it is from there outward technically as dead as if it were cut off and sealed up within a locket, for it no longer has either nervous or nutritional connection with the body except for a little external oiling

A man's natural hair turning white in a night would surprise me as much as if his wig lying on the dresser underwent a like chromatic transformation between suns

Perhaps the early (and later, also) reports of sudden grayness originated in cases of the removal "in a single night," of hair dyes when people far past middle age were ready to give up (without revealing their secret deception) the hopeless struggle of trying to keep up a youthful appearance

Forsyth, Georgia WADE HAMPTON STEMPLE



Left The man standing at the vat dips the mold into the fibrous pulp and forms a sheet of paper. His assistant turns the newly formed sheets upon pads of felt. After a sufficient pi'e has been formed of alternate layers of paper and felt, the mass is subjected to great pressure to force out the superfluous water *Right* Drying loft of hand-paper mill, where the sheets are allowed to dry out naturally after the preliminary pressing

The manufacture of hand-made paper as practiced today

Watermarking Hand-Made Papers

Some of the Details of This Obscure Art, as Practiced in Ancient and Modern Times

By Dard Hunter

BEFORE the invention of the paper making machine in the early nineteenth century all paper was made by hand In making fine papers for letter press printing, etching and engraving and for paper in which an artistic or elaborate watermark is desired the hand made process is still used

The modern method of making sheets of paper by hand differs very little from the process employed in the fourteenth century The sheets are molded in a rectangular frame over which is stretched a wire covering, like a sieve Around the top edges of this mold a movable mahogany frame is fitted which determines the size of the sheet to be made but has nothing to do with the thickness of the paper After the wet fibers have been deposited on the mold the wooden frame or "deckle" comes away so the sheet can be laid or "couched" on a piece of felting

The wire covering of the mold may be of two kinds, either "laid" or "wove" The laid mold covering has been in use since the beginning of paper making, but the wove is of comparatively recent date, having been originated by John Baskerville, the reviver of printing in England, in 1750 The oldest mold covering was made of strips of bamboo and bound together by filaments of vegetable fiber It is not known when metal wire was first used but it no doubt became a material for covering molds several hundred years before the introduction of paper-making into England in 1494

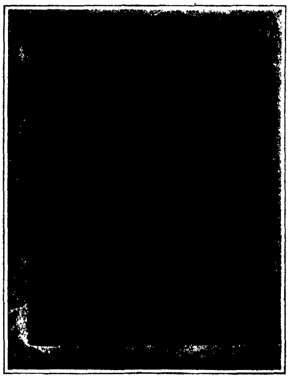
A watermark is caused by wires in the form of objects or designs sewed to the laid or wove covering of the mold In a laid sheet of paper the laid and chain lines may be seen when the sheet is held to the light and any wire work that is applied to the top of these wires may also be seen On the mold the wet pulp lies flat on its top surface but underneath where it lies against the wires of the watermark the pulp is naturally held thinner It is this thin part in contrast with the balance of the sheet that gives the transparency of a watermark These wire marks in the form of designs are held in place on the surface of the mold by means of wire stitched back and forth over the mark In some of the old watermarks it is quite possible to detect the impression of these sewing wires in the paper where they held the pulp thinner at these points

As long as molds have been used for making paper, watermarking has always been accomplished, as the laid lines formed by the bamboo sticks or metal wires of a mold caused the pulp to lie in different thicknesses, thus causing a watermark unintentionally A watermark in the form of a design or symbol has never been discovered in any of the early papers that were made on a bamboo or vegetable fiber mold The earliest mark in the form of a design or object made its appearance about the year 1301 and was made in wire A great many of the fourteenth century papermarks were composed of circles and crosses in simple forms and were mostly of Italian origin These marks were made of heavy wire which would not admit of much intricate twisting or forming into artistic or complicated shapes During the fifteenth century the wires for both marks and sewing gradually became finer and the designs were much more detailed and elaborate in character

All of the paper used in England until 1494 when the Tate mill was started, came from the Lowlands and while the material used was good the workmanship was not the best Caxton, England's first printer, in order to get sheets of an even thickness and color had to sort over paper of many different makers and dates This would account for the presence of so many different watermarks in books printed in the fifteenth century It is not uncommon to find as many as eighteen or twenty different papermarks in a single volume

Three or four hundred years ago the average workman could not read and it was necessary to appeal to him by means of pictures and symbols It is thought the watermarks were likely used to designate one sized paper from another and to give it a name To simply mark a mold with figures or letters would have meant little to the artisan of the fifteenth century so emblems were used and such marks as fools cap, hand, post, crown and pot were primarily used as marks of identification to distinguish one sized mold or sheet of paper from another.

During the fifteenth and sixteenth centuries after lighter wires came into use we find the designs becoming more complicated and different kinds of animals were pictured in abundance These watermarks were probably used to designate the sizes and kinds of paper as well as trade-marks and symbols of the makers The cock, a French mark of 1402, exhibits a deal of motion and life as does the drake of 1411 The dog from the year 1479 is indeed full of vigor; not one of these few examples could have been made by an unskilled draughtsman The human figure was not much used as a watermark



The oval is made in a different color from the margin of the sheet by stenciling out each in turn; the two portions of the sheet are united while still in the wet pulp state

Wove mold for making sheets of paper in two colors

Modern watermarking of laid hand-made paper is accomplished in precisely the same manner as it was in the fourteenth century but, as in all lines of endeavor, many minor improvements have been made. The wires used in modern times for forming the designs are usually of brass, silver plated, and are made in twelve diameters, measuring between 18/1000 to 32/1000 of an inch The sewing wires used in binding the marks to the molds are about 5/1000 of an inch in thickness Such sewing wire is too fine to leave an impression in the sheet of paper. The simplest form of watermarking is accomplished by the use of these wires twisted in the form of lettering, crests, trade-marks or any emblem where an outline design can be used

The shaded watermarks which are made in the woven wire covering are the most artistic and will admit of the most complicated form of design The woven wire is made in very much the same manner as woven cloth and with its invention new possibilities in watermarking were opened up but were not developed extensively until the middle of the nineteenth century. The weaving of these wires for mold covering is done both by hand and machine on special looms; the wires first being passed through diamond dies to insure smoothness and uniformity.

The method of making shaded watermarks was originated about seventy-five years ago by Mr W. H. Smith an English paper-maker. The process consists of making an electrotype of a model or bas-relief of the object to be reproduced in the watermark and backing it up with lead or gutta percha to hold it firm. The woven wire or gauze is then pressed into the mold or matrix and the impression in the wire is mounted as a covering on the wooden frame of the mold and used for making paper in the same manner as a laid mold It is difficult to form a shaded mark on a wove mold in the wet fibrous pulp. It requires a special treatment of the rag pulp to give a clear, sharp watermark in the sheet This method of watermarking paper is used in making portraits and all objects where an exact reproduction is desired, as it is possible to give any degree of lightness or density. The deepest impressions in the wire covering of the mold cause the pulp to lie the heaviest and the highest parts of the mold give the thinnest part in the sheet of paper. In a light-and-shade papermark the heaviest part of the design of picture will be about three times as thick as the margin or outside of the sheet while the thinnest part or highlight of the picture will be little more than a very thin film of fibers.

Watermarked note papers of this variety are used

(*Continued on page 259*)

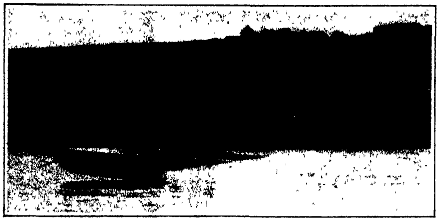
A New Type of Displacement Speed Boat

AT the recent Motor Boat Show in the Grand Central Palace, a new displacement type of motor boat named "Tarpon" created quite an interest, because it had shown high speed efficiency, and qualities of seaworthiness most unusual in a speed type of boat.

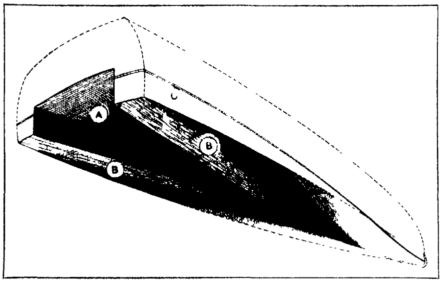
In general appearance it looks like the concave "V" bottom runabouts so familiar to yachtsmen. The secret to the invention appears in the construction of the after portion of the bottom. To illustrate this construction a sketch is shown of the boat. The wedge-shape area of the bottom as designated by "A" is 18 inches higher than the rest of the bottom "B" represents the shaded areas around the wedge-shape opening. "C" is the normal load water line at rest. When the boat is driven at speed, the concave "V" shape of the forward portion of the boat causes the boat to lift, and a considerable area that was wetted at rest is not in contact with the water at speed, and this decrease in frictional area permits any given power to drive a boat at higher speeds. This action is the same as that of the standard concave "V" bottom models. But this improvement now discloses advantages over the standard "V" bottom models, because in the area "A" some 30 sq. ft. of frictional surface is also eliminated and the result is an increase in speed efficiency of 10 per cent. At full speed the boat rides (or planes) on shaded areas "B" and the relative intensities of the shaded areas represent the relative capacity of each portion of the bottom to carry weight. This shows by heavy shading that the primary contact between the dense water and the planing surface is the most effective lifting area on the bottom. Forward of heavy shaded area the fuzzy area shown on the drawing denotes frothy, disturbed water preceding the dense contact of the water and planing area; this broken water has no lifting value.

It will be noted that after primary contact, the areas farther aft are progressively less effective as lifting or planing areas and are so denoted by lighter shading. Moreover, it will be noted that the chine areas (outside edges) of the planing areas show efficiency farther aft than the area toward the middle. This is due to the fact that in the middle areas the distance to primary contact is greater, and the fact that the concave "V" shape of bottom tends to crowd the water toward the chines quite densely. This brings us to another feature of the invention. It was found that a standard concave "V" bottom created a vacuum in the area eliminated in this new invention as shown in area "A" and caused undue settling of the stern and undue elevation of the bow. In the "Tarpon" the stern rides on the surface of the dense water and throws only a feather of thin spray off the sides as shown in the photo. Moreover the "Tarpon" takes advantage of the improvement by adding several inches to the bow freeboard thereby making it better for rough water at low speed. A standard speed runabout could not stand the added freeboard, because the bow would rise so high at speed that the driver could not see over it.

The last outstanding feature of this boat is seaworthiness, which has always been a sore point with speed-boat models. If speed were eliminated from consideration, the best model for seaworthiness would be a double ender like a life boat, because it would have its greatest displacement midship, and practically no displacement at the ends. The "Tarpon" has its greatest displacement midship, has a pointed bow and its displacement at the swallow-tail stern is very little.—By *L. L. Tripp.*



The newly-developed displacement boat running at full speed, showing how it rides with a minimum contact with the water



Bottom view of the newly-developed displacement speed boat. At full speed the concave "V" shape of the forward portion causes the boat to lift

New Uses for Old Battleships

THE United States Navy, instead of ruthlessly scrapping its old battleships by selling them to the junk man, is finding new service for them in the Navy. It is proposed to turn some of the older ships into tank barges of large capacity. To this end, the turrets, guns, armor and interior bulkheads will be removed until nothing but the shell of the ship is left. The interior will then be rebuilt to render the ships serviceable as oil tankers. One of the battleships, the "Kearsarge," famous in her day as having been, with her sister ship, the "Kentucky," the first to mount the double-deck turret is being transformed into a floating crane and our colored cover shows this craft as she will appear when the metamorphosis has been completed. The superstructure of the ship in the way of rotating crane engine house et cetera is shown in our illustration. The hull of the ship has been reconstructed with a view to giving it increased lateral stability, so that it may be able to withstand the overturning movement when the crane is lifting heavy loads at its full reach. The advantage of the floating crane is that a ship can have her guns and other heavy parts removed without having to go into dry dock or even alongside the wharf. The "Kearsarge" will be big enough to carry a heavy load of guns and armor plate wherever she may happen to be, and transfer her loads while she is moored alongside a ship.

Heat Insulators

THE Bureau of Standards has made a somewhat extended investigation of heat insulating properties of materials used in fire-resistive construction. Cylindrical specimens were heated in a suitable furnace, temperatures at different depths in the specimen being measured during the test.

Technologic paper No. 130 of the Bureau of Standards, embodying the result is now ready for distribution and those interested may obtain a copy by addressing a request to the Bureau.

Unloading Logs with Compressed Air

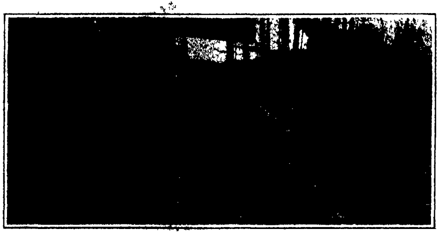
A SPECIAL device that is proving of great service in logging operations makes it possible to unload eighteen cars of logs at a pond in six to eight minutes. When the train is properly spotted at the pond the man in charge of unloading adjusts the lock pins and then gives the engineer the signal to apply the air. The engineer makes a 20-pound application, which operates the device, releasing the stakes on the side next to the pond and allowing the logs to roll freely. The outside rail of the pond track is elevated 15 inches above the inside rail.

The stakes are then put back in place, the lock pin replaced, and the car is then ready to load. One company in Arizona that uses this device now operates with just one-half the rolling stock formerly used. The time at the pond is cut very materially. One man can handle the unloading at the pond.

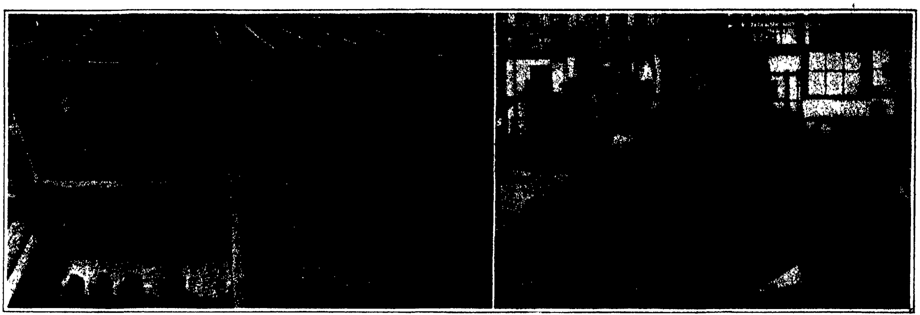
A moment after the engineer has applied the air pressure the logs are unloaded from the cars. The compressed air releases the pins which hold the side stakes in place

Tracks and Cables for the Motor Truck

AN automobile track, probably the first of its kind, is in constant use in the granite quarries of Quincy, Mass. The unique track is built on the site of one of the first railroads in the United States. It is employed to take out blocks of granite from the quarries to the shipping point, and permits heavily laden motor trucks to negotiate the steep grade without danger of any sort, even in severe winter weather. The motor trucks operate over the trough-like steel tracks without a change in the usual wheel and tire equipment, a cable being used because of the steep grades.



Track and cableway employed in operating motor trucks between the quarry and the shipping point. The track consists of two trough-shaped, steel runways, spiked down to wooden ties



Left: Each orange is scrubbed separately in revolving spiral brushes, rinsed, and sent on to be dried by air blast. *Right:* From the grading table the fruit passes through an automatic weighing machine and then between diverging rollers that allow the fruit to drop through into the proper bin, according to size

Grooming and grading oranges for the market by the latest machine processes

Putting Rejected Oranges to Work

How California Fruit Growers Are Utilizing Their Citrus By-Products

By Arthur L. Dahl

IN the growing and marketing of any kind of fruit the great problem is to cut down the percentage of loss through the discarding of fruit not quite up to standard in appearance and size, even though the quality might be just as good as the accepted kind.

The citrus fruit of California, though not of the extremely perishable kind, must nevertheless be boxed and shipped in perfect condition to withstand the exigencies of a long journey across the continent and numerous handlings by jobbers and dealers before it reaches the consumer. As most of the oranges sold in the East by the California growers are marketed on a quality basis, with strict standards as to size and appearance, it is inevitable that a large percentage of the oranges and lemons grown are discarded from shipment to the trade by reason of blemishes, misshapes, size and other causes. Such oranges and lemons are called "culls" and in the past they were virtually a dead loss to the growers, as the local markets were usually glutted and no other means were at hand for utilizing them. In a year of normal crop there are approximately 28,000,000 pounds of cull oranges, and in finding uses for this discarded fruit the California Fruit Growers Exchange serves not only its members but the public at large, for it turns an economic waste into worth.

The citrus growers of California have formed one of the most efficient and successful cooperative marketing organizations in the world, and one of the results of that cooperation is the development of a means for utilizing a large proportion of this cull fruit. The task of experimenting in the utilization of this waste was too heavy to be assumed by individual growers, but with an organization made up of several thousand orange and lemon growers it was possible to employ food chemists and erect experimental laboratories to develop uses for citrus by-products, and this, in effect, is what the marketing association did, through its subsidiary, the Exchange Orange Products Company. The Department of Agriculture aided in the work by establishing a branch of the Bureau of Chemistry at Los Angeles, and within the last few years more than $100,000 has been spent in experimental work.

While the by-products industry is still young, there are now more than 20 factories for the manufacture of marmalade and jellies from orange pulp, and considerable business is done on dried orange peel, orange vinegar and other food products. Similarly, several plants are engaged in the manufacture of citric acid and other chemicals and oils from cull lemons and oranges, and new uses are being found, from time to time, for the residue. The refuse from the citrus cull plants is even saved and used for fertilizer.

In the utilization of cull oranges, the Exchange is working along the line of converting the fresh pulp into marmalade, while the skins are used for the extraction of orange oil, for which there is a considerable demand.

The fresh cull oranges, after being sorted to take out all of the rotten and undesirable fruit, are run into an automatic slicing machine, where the fruit is cut up into small pieces, so that all of the valuable properties of the fruit may be easily got into suspension in the first cooking process.

From the slicing machine the fruit is dropped in large steam jacketed kettles, where sufficient water is added to keep the fruit from burning, and the whole mass is boiled into a heavy pulp. After a given time, this pulp is run through a continuous press, where all of the acids, fruit sugar, and other valuable properties of the fruit are pressed out and collected in a large tank, where the temperature is kept uniform and the juice standardized for all of its valuable properties.

From this tank the juice is pumped through a large filter, which has a capacity of over 200 gallons an hour, and in this filter all of the flocculent matter that is carried through the press by the juice is removed, and the resultant product is the essence of the fruit—clear, sparkling, of uniform chemical composition, and without any of the fibrous substance so common in orange products and with little or no food value.

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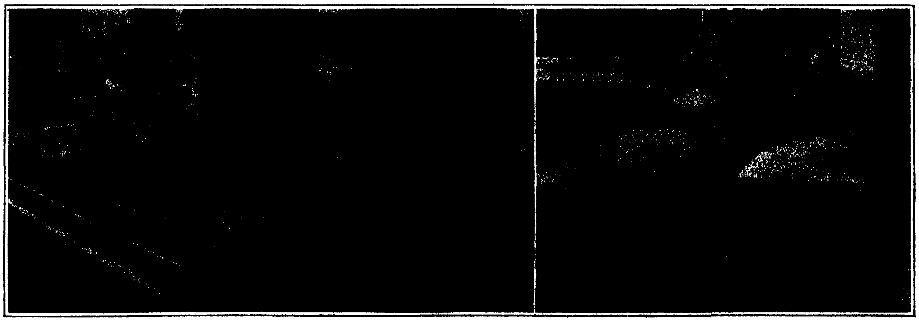

Left: After boiling in the vacuum tanks, the strong citric acid liquor is pumped into the first crystallizing pans, where, after cooling, it forms a thick black mass. *Right:* This mass is redissolved, impurities taken out, and a second boiling effected under vacuum. At the point of crystallizing, the liquid is pumped into another shallow pan to cool. This picture shows the resulting white crystals ready to be washed and finally purified for packing

Making fruit extracts out of the part of the crop that cannot be sufficiently groomed for sale raw

Using the Vacuum Tube So That the Deaf May Hear

THE problem of developing an electrical instrument that will be an aid to the partially deaf, as glasses aid those whose vision is defective, has engaged the attention of some of the world's greatest scientists and physicians

Considerable progress has been made in the development of telephonic hearing aids for the deaf, but due to the inherent limitations of the telephone transmitter and receiver, development along this line had apparently reached its limit when what is nowadays known as the "vacuum tube amplifier" opened a new field for research and development Due to the fact that it is a distortionless amplifier of minute electrical impulses it is adaptable for use in an electric circuit between the telephone transmitter and receiver In other words, it conveys and reproduces human speech more clearly and loudly than any electrical hearing aid so far produced.

It has remained for Earl C Hanson of Washington, D C, to apply the vacuum tube amplifier as a hearing aid for the deaf The result of his extensive work with vacuum tube amplifiers is represented in the highly compact set shown in the accompanying illustration, which is intended for the use of persons more or less deaf This set may be used anywhere being quite portable and entirely self contained

One of the great difficulties encountered heretofore has been that in the effort to obtain volume, the transmitter has been overloaded, causing a roaring or under tone in the receiver Telephone engineers and those familiar with the characteristics of the vacuum tube agree that it amplifies feeble currents without distortion This permits the use of a telephone transmitter without overloading and thereby retains the clear speech received over line wire telephony Persons with normal hearing, and even those who hear poorly, hear distinctly on the standard wire telephone Many persons afflicted with deafness use the telephone satisfactorily, even though they have difficulty in distinguishing ordinary conversation The reason for this is that the telephone apparatus concentrates the sound in the ear

Mr. Hanson's device consists of a more or less in-

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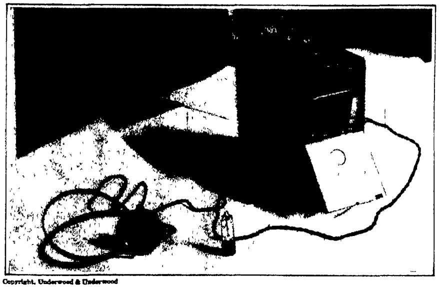

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Vacuum-tube amplifier set developed for aiding persons of poor hearing. Note the diminutive vacuum tube near the pair of telephone receivers

Making Barrels Out of Paper

IT appears as though the barrel problem which is an important one in many industries, has been solved at last A highly ingenious machine which may be installed in any plant and operated by anyone, makes it possible for an organization to make its own barrels out of paper The paper is bought in rolls, and the barrels are made as needed Hence there is no waiting for the barrel man to deliver the barrels ordered the machine is operated for twenty-four hours if need be or not at all, according to the immediate demand for barrels, the paper in the form of compact rolls takes up little space as compared to empty barrels, and the paper barrel is a lighter and tighter container.

The paper barrel machine is the invention of George C Snyder of New York City although its development to the commercially practical stage has been brought about by others As will be noted in the accompanying center view showing the machine, it consists of a two part mandrel which is capable of being rotated by power and also of being more or less drawn apart a paper feeding and coating mechanism a slitter, and a collection of accessories for controlling the size and thickness of the barrel being turned out To start the operation, the end of the roll of paper, which passes through tension rollers and over the coating mechanism which coats one side of it with the adhesive liquid, is drawn on to the mandrel and inserted in a slot The mandrel is then rotated by power for a certain number of turns, after which a slitting wheel is brought into action for cutting the paper into two strips Then the

(Continued on page 260)

Copyright Keystone View Co.

Left Cutting the paper strip as the final operation in making a paper barrel *Center:* The paper-barrel machine, showing the two-part mandrel with end of the roll of paper inserted in the mandrel slot, and the paper-feeding and coating mechanism at the rear *Right* Placing wooden ends on the paper barrels. The ends here shown have been discarded more recently in favor of either a more substantial wooden end, or, better still, a pressed steel end piece which fits on tightly and reinforces the barrel

How rolls of paper are converted into paper barrels as fast as they are required for shipping purposes

Combined Tire and Caterpillar Tank

A MOST interesting demonstration was recently given at Hoboken, New Jersey, when new types of vehicles under construction for the Ordnance Department of the United States Army at the plant of the Front Drive Motor Company were maneuvered before officers of the Ordnance Department and other interested branches of the service Gun mounts and a tank were run over a specially constructed obstacle having a slope of thirty-five degrees on one side and of forty-five degrees on the other The vehicles climbed up and over this obstacle with ease

Probably the most important feature of these new vehicles which are being developed jointly by the officers of the Ordnance Department of the Army and Mr Christy is the remarkable method of progression Ordinarily, when they are in motion, the machines perform like the usual caterpillar tread vehicles, but when high speed is desired over good roads, the tracks are removed and the vehicle runs along on its wheels at

(Continued on page 260)

Officers of the U S Army Ordnance Department watching a demonstration of a new type caterpillar self-propelled mount for a 155 m.m. rifle at the plant of the Front Drive Motor Company, in Hoboken, N J. The mount, designed by Mr Walter Christy, has many new features and improvements over the type now in use

New caterpillar gun mount and small tank demonstrated for Army officers

With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

What Poor Packing Really Means

WE have heard a good deal regarding poor packing, especially from our friends abroad to whom we have shipped goods in the past. It seems impossible that the stout cases which leave the *American plant* should arrive at their overseas destination badly battered and broken and even pilfered, yet such is often the case. The accompanying photographs, made at various South American ports, show the sad experience with more than one American shipment.

Fortunately, the American shipper has learned a good deal about packing *in the past few years.* There was a time when our packing was simply impossible and it did us no end of harm in curtailing the growth of our export trade. That was the time, too, when British and German firms took consummate care with their packing, resulting in the safe delivery of their merchandise in all parts of the world.

Today the successful American exporter has learned to pack his goods in the proper manner, and one is often surprised to find heavy merchandise, such as machinery, so well protected in heavy boxes and cratings that the packing appears to be overdone. The larger companies doing an extensive export business maintain elaborate carpenter *shops for making cases and crates, and* use lumber in what appears to be a lavish manner.

However all that may be, those firms have probably learned through bitter experience the necessity of packing as well as they know how, and making due allowance for no end of rough handling.

A crate of wire wheels as it was received at Callao, Peru, after shipment from the United States

Speeding Up the Handling of Ashes

HOW much does it cost you to handle ashes? Taking everything into account—labor costs, upkeep, depreciation, operating expenses, capacity—how do ash handling costs figure in your overhead? You keep a close watch on the cost of other operations entering into production. The same watchfulness should be applied to ash handling in your plant, for, as is too often the case, it may be one of the most expensive phases of your boiler house maintenance.

With a view to reducing ash handling costs to a minimum, there has recently been introduced a new method which is simplicity itself. It is known as the skip hoist system, and consists of a bucket running on an inclined or vertical track and hoisted by a steel cable winding machine, a hoist house and steel bunker. The ashes are collected from hoppers under the boiler by a small push or electric car. The ashes are dumped into the bucket. The pushing of a button sends the bucket up the track, dumps the ashes into a cylindrical steel bunker and returns the bucket for another load. The entire operation is automatic. A small sized skip hoist will easily handle eight tons of ashes an hour.

There are several features that recommend this system of ash disposal. The unskilled laborer operates the entire job. The skip hoist is a mechanical ash handling system that is unaffected by the destructive abrasive action of hot, dripping, wet ashes and grit. Repair bills are minimized. The consumption of minimum power means low operating cost. The elimination of complicated parts means less breakdowns and resulting repairs.

Turning Waste Paper Into an Asset

WASTE paper as such is worth little, and, furthermore, it is a menace about any plant. It should be baled and shipped direct to the mill in order to get it out of the way and realize its full value.

An indestructible, all-steel, hand-power baler has recently been introduced which serves the purpose of the average plant. It has a large open top, easy to fill, and may be readily operated by anyone. The litter and waste of the plant are placed in the machine and in a few minutes are converted into compact bales occupying but little space and representing a minimum fire risk. It may be used for baling paper, rags, wood or steel shavings, leather scraps, excelsior, cloth clippings and so on.

It is interesting to note that the paper barrels described elsewhere in this issue are made from chip board which in turn is made from waste paper, rope and other odds and ends. The conservation of such waste must result in cheaper chip board.

Left: Transferring American packing cases from the steamer to the lighter at a South American port. Note the condition of the packing cases, which have been unable to withstand the long journey. *Right.* What happened to a flimsy crate containing cans of paint. Is it any wonder that goods are stolen in transit?

What poor packing methods mean to the South American buyers of our goods

How Dobbin Pulls

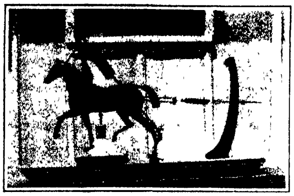
A SMALL horse stands in the laboratory of the Department of Agricultural Engineering at the University of Wisconsin, which was designed by the late Professor King in order to study the effect of the angle of trace, of the hock muscle, and of the distribution of the horse's weight upon the draft

To determine the effect of the angle of trace, Professor King attached a steelyard scale to the traces and, back of an arc, a screw with which he could increase the pull on the traces Then, setting the traces at a particular angle, the screw would be tightened until the fore feet of the horse were just raised from their base. In this position he was exerting his maximum draft. It was found that when the traces were below the horizontal the horse exerted more draft than when they were on the horizontal and that the draft decreased as the traces were raised, at an angle of twenty degrees the horse could exert twice as much draft as at zero degrees The traces at an angle have two effects: one, of making it more difficult to raise the horse from his feet, and the other, of tending to lift the wheels of the vehicle over obstacles rather than dragging it over

The hock muscle is probably of as much importance as the angle of trace. It is the straightening of this muscle which pulls the load forward, so that the stronger the muscle the greater the load moved In the model the tension of the hock was about twice that of the draft and, while the same may not be true of a living horse, it serves to show how very strong the muscle must be to pull as it does

Men may change the angle of trace, but they cannot change the hock muscle nor can they change the distribution of weight The horse must be selected with regard to the last two for the distribution of weight is also of importance The horse is a lever with a fulcrum at the hind feet and, properly placed, weight will greatly influence his ability to pull Using movable weights Professor King found that when weight was placed at the center of the animal and the traces at the horizontal the horse could exert an additional draft equal to the weight added, but that if the traces were at an angle of twenty degrees the increase was double the weight Other things being equal then, the heavier the horse the greater the draft When the weight was placed at the forequarters the increase in draft was more apparent but when the weight was at the hind quarters the effect was less This is what one would expect since the longer the lever arm the more effective the weight operating upon it. Therefore the desirable draft horse has heavy forequarters and not so much weight at the hind quarters, substituting there a strong hock muscle for weight

The model horse is still working, for it is now being used by the students to determine for themselves the truth of Professor King's findings



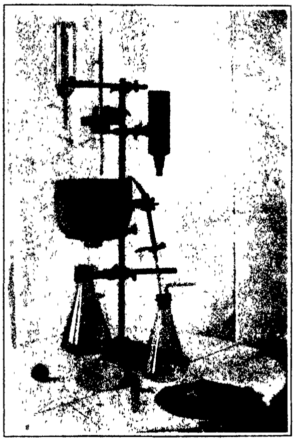
Model horse that demonstrates the best angle for the trace

Paraffin Percentages

ROAD-BUILDING materials should be evenly proportioned with respect to their various component parts, otherwise an excess of one ingredient to the sacrifice of another may determine ultimately the difference between a durable highway and one where the outgo for maintenance bulks big. For instance, the presence of paraffin, a white crystalline substance, in shale and other bituminous road materials suggests the necessity for the examination of products entering into the construction of highways The determination of paraffin scale is made possible by an apparatus designed by the United States Bureau of Public Roads

The novel feature about the apparatus is the administration of the water bath. The latter is arranged with a temperature control to maintain the water at a specified temperature, which is usually 25 degrees centigrade for the paraffin determination test The bath is heated by means of an electric resistance coil located in the bottom of the miniature water pool The coil is controlled through a telegraphic relay by means of toluol-mercury temperature regulator provided with electric contacts

The complete equipment for making the paraffin determination consists of One-half pint iron retort a piece of iron tubing 30 inches long, two 100-cubic centimeter Erlenmeyer flasks, 500 cubic centimeter flask with side neck for filtering under pressure, freezing apparatus, 6-inch test tube of three-fourth-inch diameter, analytical balance of 100 grams capacity and sensitive to 0 1 milligram, a rough balance of one kilogram capacity and sensitive to 0 1 gram, wash bottle, seamless pint tin cup, vacuum pump and connections, glass crystallizing dish of 50 millimeters in diameter steam bath, desiccator with calcium chloride, 4 inch steel spatula, Bunsen burner with rubber tubing, and two iron stands with retort clamp and one ring



Apparatus that shows the paraffin in bituminous road materials

Photographing Snowflakes

NEXT time it snows, as the first few flakes are gently wafted toward the earth, pause a moment before you crush them ruthlessly under foot, for in these minute particles of frozen moisture nature has created decorative designs that for delicacy of effect and fairy-like beauty equal anything that man has been able to devise

During the many years that he has devoted to this particular work, Mr W A Bentley of Jericho, Vt, has made 3,800 photomicrographs of snowflakes and has found no two of them alike As a result of his exhaustive study he firmly believes that the snowflake is the most exquisite example of nature's art

His work has been difficult and has entailed all of the patience and forbearance of the true scientist However, he has been rewarded for his years of labor

The great appreciation that they have received has been a reward in itself to this farmer scientist As well it has amazed him When he began this seemingly unimportant study he started to make a series of drawings of the flake designs These drawings, of which about four hundred were made, proved unsatisfactory Dry plate photography seemed to afford a medium that would make the photographing of them possible Mr Bentley secured an apparatus consisting of an extension camera coupled to a microscope and capable of giving from eight to sixty diameters magnification (from 64 to 3,600 times) Failures came in rapid succession, but with new methods clear, sharp images were at last obtained

However he soon saw that it was impossible by any purely photographic method to show the crystals naturally white on a black ground So he tried the tedious blocking out method of cutting the negative film away from around the snowflake image It proved to be a task of monumental proportions, and yet one that must be successful as it was the only means of bringing to light their real beauty

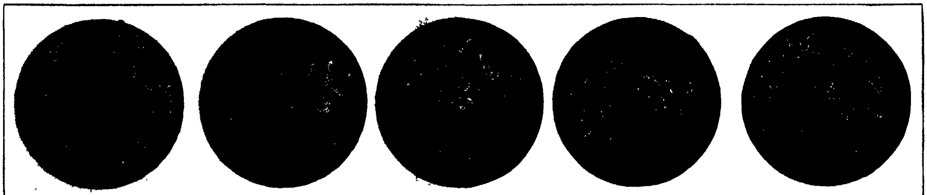
Mr Bentley feels that it is impossible to convey an idea of the extreme fascination of the work

The task of photographing the snowflakes is one that is more delicate than difficult The utmost haste must be used as once the crystals are separated from the mass they evaporate very rapidly, and never last more than a few minutes even when it is extremely cold

The crystals are usually caught on a black board as they fall and are then removed to a glass slide under an observation microscope Only a brief glimpse of them is possible, during which it is necessary to hold one's breath If suitable they are placed down on the glass slide with the aid of a feather after which the slide is placed on the stage of the microscope, centered, focused, and an exposure of from ten seconds to several minutes given, according to magnification and cloudiness Ordinary daylight is used, for illumination, the apparatus being pointed out of a window for this purpose

Snow crystals are remarkable in many ways for quantity, distribution origin, and all the important parts they play in nature's plan Although built usually according to the rule of six, every crystal grows in kaleidoscopic fashion from start to finish, and almost every moment in cloudland sees them changing form They are perhaps the most varied and exquisite examples of nature's art

These ever varying outgrowths while uniting to the parent crystal ofttimes do so imperfectly or in such a manner as to bridge over and imprison minute quantities of air, forming tiny air tubes within them, or diffuse shadings, which outline more or less perfectly the transitory shapes These present the appearance of lines, dots, and fairy-like geometrical figures in endless variety, and give exquisite beauty, richness and complexity to their interiors



Some of the striking forms taken by snow crystals, as shown up by photography against a black background—an old story in somewhat new dress

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Copyright Kadel & Herbert

The non-sinkable mail bag and the non-sinkable suit

Mail Bags That Won't Sink

IN a recent test and demonstration special bags were taken up in airplanes and dropped from a height of 300 *feet into the water and then picked up* by a small boat The bags were found entirely satisfactory, and it is claimed that they will float on the water for an indefinite period when thrown from air planes sinking ships and so on The bags may be picked up by a small boat sent out from shore or from a steamer, or again, by a man equipped with a non sinkable suit such as is shown in the accompanying illustration

Making Window Cleaning Safe

HOUSEWIVES who delight in having their home spick and span will delight in the new window construction which is shown in the accompanying illustration, and which is claimed to make window cleaning a safe task This window construction is the invention of Mr Sixt and Mr Bingham of Brooklyn, N Y The center bead and molding which together hold the windows in place are cut at an angle of 45 degrees allowing a section three inches longer than the window to be removed. These strips are then held in place by specially constructed spring snaps. The removal of these strips allows the windows to be drawn inward and the window is then held in position by a construction somewhat similar to a hinge which fits into the wood When not in use this can easily be fitted into the wall, out of sight

Special construction for windows which permits window to be swung in for cleaning

A Telephone Which Fits in the Ear

THAT much abused term, "the smallest in the world," is again being used, this time in connection with the tiny telephone receiver shown in the accompanying photograph A German concern has developed this small telephone as part of a set for deaf persons, and the idea is to have the small telephones fit inside the ears of the users so as to be as inconspicuous and out-of-the-way as possible The telephone is a perfect bipolar receiver, and has a diameter considerably smaller than the 5-pfennig coin shown beside it

Whether it is the smallest telephone receiver or not, is a question It seems *that the thermal telephone*, which was described in these columns several years ago, is still smaller and also fits in the ear of the user However, the thermal receiver works on the principle of air expansion due to the heating of a small platinum wire The purity of sound obtained with the thermal telephone receiver is remarkable, and far superior to the general run of telephone apparatus, due to the absence of a diaphragm In this connection it is very doubtful if the present telephone receiver with its tiny diaphragm can reproduce speech as clearly as the usual telephone receiver of far greater size

Tiny telephone receiver which is worn in the ear, and measures less than diameter of a dime

A Grease Gun for Every Bearing

A NEW grease cup has been perfected by a Mr Davis of San Francisco, Cal, which is practically a little grease gun for every bearing and does away with *all the troubles that other* grease cups have such as leaking through the threads or the plunger, losing the top, crossing the threads, and refilling It is easily and quickly filled because there are no threads to re-enter, thus saving both time and grease

One of the leading features of this cup is the spring metal plunger This is a thin spring metal plunger, slightly concave, like a shallow saucer. It exerts a firm, uniform pressure against the sides of the barrel, making the cup dust-proof, leak-proof, grease-tight and oil-tight

Not merely grease but oil may be applied with any required pressure just as with the use of a grease gun It insures reaching all dry or dirt-encrusted parts, procuring positive and thorough lubrication. All grease or oil goes into the bearing and not a particle goes on the outside of the cup, according to the inventor.

The new cup is easily and quickly filled The metal cup is opened and put back as shown Compare this with the old screw telescope cups, the ever-recurring bother of re-entering the thread with the danger of crossing threads, thus making the cup leaky and worthless

Another feature is the unit mechanism The plunger and top are fastened to the barrel, one cannot lose or mislay a part After filling the cups there is a surplus that can be used instantly with just a turn of the plunger

Turning Pliers Into Self-Opening Shears

WITH the attachment for pliers shown in the adjacent photograph, a slip-joint design can be turned into a pair of self-opening shears It is only necessary to snap on this new shear attachment The work takes but a few seconds and the convenience of having a tool of such a combination in garage or workshop is self-evident. The attachment *will cut wire and metals* not exceeding in thickness a medium gage

A simple attachment which converts ordinary pliers into self-opening shears

A Ball-Bearing Ventilator

AN American manufacturer has recently brought out a rotary ball-bearing ventilator which is said to maintain a steady flow of fresh air without operating expense It applies the free power of the passing breeze to create a suction This ventilator is provided with a fin which causes it to face in the proper direction, no matter how slight may be the breeze, as well as with a set of shutters which may be closed in order to reduce the suction

Playing Safe with High Voltage Circuits

WOOD, from which the safety platform shown in the accompanying *photograph* was made, is specially treated so that contact with 25,000-volt circuit will not hurt this workman as long as he is standing on this platform There will be a discharge to his hand as he makes or breaks contact, due to the capacity of his body, but the platform itself has no capacity so that after contact is made there is no sensation felt

Similar platforms, provided with railings and suspension members, are now being employed in "live" line work Such platforms, while ensuring safety, do not handicap the linemen in their work The linemen can now make repairs without the inconvenience of shutting off the power.

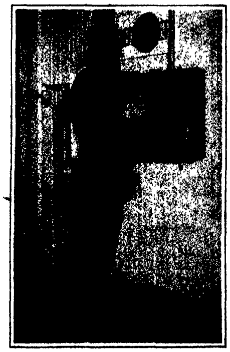
Two of the newly-developed grease cups, shown in use and opened

Recent Patent Decisions

Good Faith Is Not Sufficient in a Trade-Mark.—This is an appeal from a decision of the Patent Office overruling the opposition of the Proctor & Gamble Co to the application of Eney Shortening Co for the registration of the sign "Esco" as a trade mark for a lard substitute

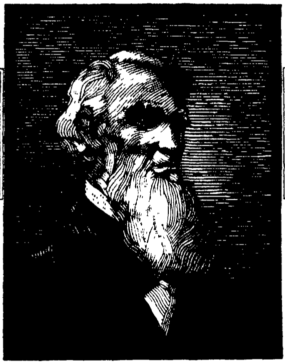
The opposer shows that it is the owner of the sign "Crisco" as a trade-mark for a lard substitute, and alleges that as its goods are of the same descriptive qualities as that of the applicant, the marks being similar, confusion would be likely to result in the minds of the public

The applicant says that its mark is made up of the initials of the corporation with the termination "Co," and seems to think that there is something *in that which should entitle* it to have the mark registered The court denies the force of this argument, and decides to reverse the opinion of the lower court and to hold that the use of the sign "Esco" would cause confusion with the sign "Crisco" It is held that the trade mark statute takes no account of the origin of a mark, the only question being, would its use be likely to result in confusion? In which case it is unregistrable—*Proctor & Gamble Co. v Eney Shortening Co U S C C A of D C.*



Standing on this little platform of specially treated wood protects the electrician from shock

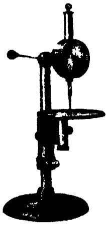
THE SCIENTIFICALLY BUILT WATCH



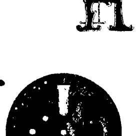
AARON L. DENNISON
Pioneer of American Watchmaking and the Waltham System of Standardisation

ACCURACY

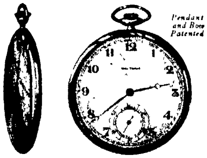
The Twelfth Part of a Human Hair as a Standard of Measurement



Standing Gauge



Lower Plate



Waltham Colonial A

Extremely thin at no sacrifice of accuracy
Maximus movement 21 jewels
Riverside movement 19 jewels
$200 to $325 or more
depending upon the case

IMAGINE the twelfth part of a human hair being the difference between Waltham standardized accuracy and the variable guesswork in foreign watches.

Waltham produced, by Waltham genius, methods of measurement and gauges to measure so infinitely accurate that the Waltham Watch *became* and *is* the most perfectly constructed watch in the world.

If in the lower plate (illustrated) there was a measurable difference between the location of one bearing from another, it would mean irregularity in the time-keeping performance of that watch Waltham has so perfected unique gauges and standardized a system of infinitesimal measurement, that such a minute error *cannot* occur in a Waltham Watch without discovery

What does this Waltham accuracy and close inspection mean to you?

When you buy a Waltham you possess the world's most accurately made watch. You own a watch that can be readily, and what is most important to you, perfectly and economically repaired—at an upkeep cost at least 50 per cent lower than the repair of foreign made watches whose method of less accurate manufacture has not kept pace with Waltham genius which is American.

That is why we say truthfully—"Waltham placed America first, in watchmaking" This is one more good reason why you should own a Waltham

This story is continued in a beautiful booklet in which you will find a liberal watch education. Sent free upon request

WALTHAM WATCH COMPANY, WALTHAM, MASSACHUSETTS

WALTHAM

THE WORLD'S WATCH OVER TIME

Where you see this sign they sell Waltham Watches

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of Interest to Farmers

BLOWER DEVICE.—P Comina, Aptos, Cal This invention has particular reference to a pneumatic blower device for recovering and cleaning fruit which has dropped on the ground around the base of fruit trees The prime object is to provide means of separating dust, twigs, leaves etc, from the fruit, and to so arrange the device that it may be used in connection with a conventional blower apparatus

Of General Interest

ADJUSTABLE LEG FOR SINKS AND OTHER ARTICLES.—O M Redlon, 181 Front St Bath, Me The object of the invention is to provide a supporting leg having means permitting the same to be vertically and laterally adjusted The structure includes a head with spaced sides and top the top having longitudinal slots therein, caps U shaped in cross section adapted to receive the article to be supported, and bolts passing through the slots adapted to secure said caps in adjusted positions

BACKBAND HOOK.—G C Williams, Lombardy, Miss The invention relates to harness, and particularly to a backband hook having locking means to engage the trace Among the objects is to provide means by which the hook may be readily applied to backbands of known form locking means to prevent the accidental release of the trace, the hook and its appurtenances being prevented from exerting any rubbing action against the sides of the animal

METHOD OF AND APPARATUS FOR THE PRESERVATION OF BODIES AFTER BURIAL.—V Branciforti, 311 E 109th St New York, N Y An object of the invention is to produce strong and substantial burial coffin or casket in which the body may be indefinitely preserved It is a further purpose to provide such a coffin or casket having means for containing certain chemical preservatives which act on the body to preserve the same

FUR BUTTON.—B Cohen, decd address Amelia B Cohen, c/o Baker & Obermeier, 84 Nassau St, New York, N Y This invention has for its object to provide an imitation seal fur button, arranged to provide the desired uniform fullness the same as is found in real seal buttons, and to insure long wear without danger of the button being rubbed thread bare by use

FASTENING DEVICE FOR CONTAINER COVERS.—C W Dobelin, 619 W Mifflin St, Madison, Wis The object of this invention is to provide a fastening device in the form of staples for container covers which can be detachably applied to secure a cover in position to close a container without the necessity of nailing the cover to the container, whereby a cover can be used repeatedly thereby effecting a great economy

DAVIT.—A J Dawson, 21 Edwyn Ave, Portsmouth, N H The invention has particular reference to balanced davits an object being to provide a mounting therefor and operating means which results in balancing the weight of a boat so as to reduce to a minimum the power necessary to swing the boat A further object is to provide a construction which may be used for other purposes than supporting the boats, such as transporting loads from one position to another

APPARATUS FOR THE MANUFACTURE OF OXYGEN COMPOUNDS OF SULFUR.—T A Clayton, 48 Rue de la Victoire, Paris, France This invention more particularly relates to an apparatus in which the air required for the combustion, volatilization and oxidation of the sulfur, is forced into the sulfur combustion furnace at two different levels, so that the secondary air current may not interfere with the outflow of the gases carried over the primary air current, thus avoiding the back flow of the said gases toward the hearth

Hardware and Tools

CAN OPENER.—B G Worthington, 19 N Fir St, Medford, Oregon The invention relates more particularly to an opener having a pair of knives and movable in either direction around the top of a can for the purpose of opening the same the object being to provide a simple implement adapted for either right or left handed persons, as well as for the use of one knife after the other has become dulled.

PIPE LIFTER.—W H Schultz, Bartlett, Ill An object of this invention is to provide a device by means of which a pipe used in connection with gas wells, artesian wells, etc., may be quickly raised and with no danger of the pipe slipping during the raising operation. A further object is to provide a tool which is simple and therefore not easily liable to get out of order

LOCK.—H D Wethling, 45 Mountain View, Orange, N. J This invention has as an object to prevent the reading of the dial of a permutation lock when the same is being opened, thus preventing an unauthorised person from tampering with such lock by trying to open the same for his own personal benefit subsequently

KITCHEN TOOL.—E. Verstraete, 615 Washington Ave, Belleville, N J. Among the objects of the invention is to produce a tool for use in kitchens, and in cooking over a camp fire or the like, and more particularly the invention relates to a tool having a tosser element for tossing pancakes or lifting other food for which a broad blade is required, and for lifting pot or pan covers or for lifting small cooking utensils

NUT LOCK.—T M Hilsabeck, Lusk, Wyoming The prime object of this invention is to provide a nut lock formed of the material constituting the body of the nut and unitary and integral with the nut structure Another object is to provide a nut lock in which the locking elements are accessible to be easily and quickly released and are remote and protected from the strains and stresses incident to the operation and use of the nut

FISHING TOOL.—H Currier, address Harry Wymore, Rose Hill, Iowa This invention has particular reference to tools for fishing, dull bits and other implements from wells An object is to provide a device which upon being lowered into a well or other boring is adapted to engage and hold the object to be removed A further object is to so arrange the grappling tongs that a variety of different objects may be readily removed from a boring

Machines and Mechanical Devices

TYPEWRITER ATTACHMENT.—W D Reid, 334 Macon St, Brooklyn, N Y The invention relates to the cleaning of the face of type by an operation which is rapid, and will not soil the fingers of the typist The device comprises an eraser presenting a pair of side faces, and bristles associated with one of the faces forming a brush, against which the type which has become clogged may be struck for cleaning the same, the brush may be associated with the type guide and is not likely to become lost

COMPOSITION OF MATTER FOR SEALING PISTON RINGS.—J W Calta, Platte, S D An object of the invention is to provide a composition of matter for sealing piston rings so as to prevent oil, gas, etc, from passing the ring A further object is to provide a composition which will stand high temperature, and which is in itself a lubricant The composition consists of a refractory lubricating paste comprising soapstone, mica, asbestos fiber, flake graphite, fine plumbago and mineral oil

SKIN STRETCHER.—S and B. Friedman, c/o Reliable Machine Works, 48 Lafayette Ave, Evergreen, N Y An object of the invention is to provide a stretching means located at an angle or incline so that when the stretching operation is ended the skin will fall by gravity from the stretcher A further object is to provide means for forcing the stretcher bars apart, allowing the bars to adjust themselves to the parallel or angular shape of the skin, and to provide means for reversing the skin when it is drawn from the stretcher

COMPRESSOR.—G F Krieger, c/o Krieger Tool and Mfg Co, Grand Rapids, Wis This invention relates to compressors such as are used in refrigerating machinery, for the transformation of a refrigerating medium from gas into a liquid Among the objects is to provide a reciprocating piston structure having an active piston head at each end while the body of the piston intermediate of the heads is provided with a longitudinal bore through which gas may be admitted and passed laterally outward through a plurality of ports, and thence through the piston head past a valve fitted movably in the piston head.

Medical Devices

THERMOMETER COVER.—D H. Mills, 2 Ford Ave., Oneonta, N Y This invention has for its object to provide a cover of flexible elastic material that may be used during the use of the thermometer to avoid the necessity of washing, drying or the like after use, and to prevent the swallowing of broken glass or mercury in case of breakage, and to provide a sterile or aseptic way of taking temperatures and prevent the transmission of infections and contagious diseases.

CUPPING DEVICE.—T. H Springer, 828 Broadway, Waterloo, Iowa An object of the invention is to provide a device by means of which body parts, such as the breast, may be stimulated to produce a flow of blood to weakened or diseased parts by simultaneous electric and vacuum treatments, the device being constructed to hold warm water through which a current is passed while the body to be treated is in contact with the liquid, the cupping device may be easily operated by the patient

Musical Devices

EXTRACTOR FOR PIANO HAMMERS.—B J Starks, c/o A H Shoemaker, Eau Claire, Natl Bank Bldg, Eau Claire, Wis The invention relates to a device arranged to readily operate upon the head, the butt, or the back stop of the hammer A more specific object is to provide a device which may be quickly applied to the hammer in a manner tightly clamping the shank from which the hammer head or other member is to be removed

Prime Movers and Their Accessories

APPARATUS FOR FACILITATING THE SUPPLY OF OIL TO ENGINES OF MOTOR CARS OR OTHER ENGINES.—W J Dalby, 10 Orient Rd, Magill, South Australia, Australia This invention has been designed to simplify the procedure of supplying lubricating oil in predetermined quantities to the engine of a motor car The device comprises an upper receiver for holding the oil in bulk, a lower receiver for containing the predetermined quantity of oil to be fed, a valve connected between the two receivers and a valve connecting the lower receiver with the engine The taps to the upper and lower receivers may be operated independently or by a rod so that when one is opened the other is closed.

Railways and Their Accessories

DRAFT GEAR.—G M Schwend, 1928 W 13th Ave, Birmingham, Ala The invention has for its object to provide a gear of the character specified especially adapted for use with locomotives of any character, and so arranged as to prevent jerking of the cars in starting and in stopping The device is operated by means of the draw bar which is connected with compressed air cylinders by which the movements of the locomotive will be cushioned

CONTINUOUS RAIL CROSSING.—C. M. Rihn, decd, address Jas M Rihn, 1808 W Main St, Louisville, Ky The purpose of this invention is to provide a track crossing which eliminates the usual gaps in the surfaces of the track rails at the points of intersection, whereby the usual objectional and detrimental jars to which a car is subjected in traversing a crossing are eliminated

DANGER SIGNAL.—P. M. Feltham, Edgefield, S C. The invention relates more particularly to danger signals for road vehicles adapted to warn the driver of an automobile or other vehicle of the proximity of a railroad crossing dangerous curve or other danger. An important object is to provide a device which will not impair the smooth surface of the road, the yielding obstruction ocered to the passage of the vehicle being such as not to occasion discomfort to the occupants, or become interfered with in any manner by sand, snow or ice.

Pertaining to Recreation

TOY.—E J Cedarberg, 346 Bloomfield Ave., Caldwell, N J. An object of the invention is to provide a toy which represents a kangaroo and which is adapted to be ridden by a child and in its movements assimilate the movements of a kangaroo. A further object is to provide a toy which can be sold at a reasonably low price, which will be attractive in appearance as well as beneficial physically to a child using the same.

TENNIS RACKET.—P. A. Vaile, 565 W. Washington Blvd, Chicago, Ill. Among the principal objects which the invention has in view are to enable the game of tennis to be played within restricted bounds, to train players of the usual game of tennis in the art of volleying, and to avoid rebounding of the ball The desired result is accomplished by a racket comprising an open frame of the usual type with a loosely formed net producing a tendency to deaden the ball

GAME DEVICE.—C. V. Torrey, 137 Front St., Marblehead, Mass. This invention has particular reference to a game device employing a surface projectile which is adapted to be projected over a playing surface to knocking down vertically presented pins, as in the game of ten pins and the like. This object is accomplished by the provision of a mechanical manikin constructed to enable the arm thereof to impel the projectile as thrown by a bowler down a bowling alley

Pertaining to Vehicles

AUTOMOBILE LOCK.—R. R. Stabler, 702 Fidelity Bldg, Baltimore, Md The invention relates to locks for steering wheel shafts. The foremost object is to provide a lock that is operatively combined with the ignition circuit in such a way that the ignition circuit is broken as the lock is moved into the locked position, and is so arranged that the ignition circuit cannot be broken until the lock goes into place

TIRE.—W D Hook, 309 W Waldbrig St., Savannah, Ga. This invention has for its object to provide a tire especially adapted for motor vehicles and capable of being attached to the usual wheel for providing a nearly as possible the resiliency of a pneumatic tire without the liability of the said tire to injury from punctures, blow outs and the like

DEMOUNTABLE RIM.—L. H Krickel, address Chas Schulze, Monroe, La An important object of the invention is to provide a demountable rim of great strength and durability, which is positively supported and secured with its parts locked in assembled position upon the wheel, but which may be readily removed from the wheel and readily and easily demounted.

LUBRICATOR.—E J Timerman, 232 Crescent Ave., Syracuse, N. Y. The present invention relates generally to lubricators, and pertains more particularly to lubricators for vehicle spring shackles. It is the prime object of the invention to provide means by which the lubricant may be effectively applied to the bearing surface of the spring shackle.

CASING HOOK.—P S. Brooks, Jr, Sewanee, Tenn The invention has for its object to provide mechanism of the character specified, by means of which an old casing or a number of pieces of casing may be firmly secured on the outside of a worn tire to permit the worn tire and the worn casing sections to be utilised. The device comprises a yoke-shaped body adapted to fit about the felly and double hooked arms extending radially of the felly to hold the casing.

SPRING SUSPENSION PIVOTAL ATTACHMENT FOR THE WHEELS OF MOTORCYCLE SIDE CARS.—H. Christiansen, 77 Raadhusplads, Copenhagen, Denmark The invention relates to a wheel or wheels for use with a side car connected with a motorcycle. An important object is to provide a wheel mounting whereby suitable springs may be connected and whereby the wheel or wheels of the side car are free to turn in steering operation.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

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Railroad Accidents and How They Work

(*Continued from page 241*)

is taken by the 887 crossing accidents, which managed to do away with the lives of 875 people. It is clear enough that about the surest way of getting killed by a train is to stand on the track and let it hit you—that this is much surer, even, than to be aboard a train that gets violently spilled off the right of way by impact with another train. The collision, however, maintains third place, with a death roll of 67. Next to it stands the derailment, accountable for 42 deaths in the period discussed; and 35 people were killed because they couldn't wait for the next train or because they had no time to allow the train on which they were riding to come to a full stop before alighting The engine defects could not have been in general so serious as the one we have pictured, since they cost the lives of only 8 men; and a like toll was taken by miscellaneous accidents

On the percentage basis again, the service accident accounted for 45 per cent of all the people killed—practically the same showing as that made in frequency, the crossing accident for 39 per cent; collisions for 7 per cent, derailments and boarding-and-leaving accidents for 4 per cent each, more or less, and engine defects and miscellaneous accidents somewhat under 1 per cent each

Comparison of the two percentage showings makes it quite clear, as of course we should have known, that the seriousness of accidents is not constant We can perhaps get a line on this by figuring up the average number of persons killed for accidents of each sort--something which our drawings do not directly do We find that in order to represent the results as whole numbers we shall have to put them in the form of so many accidents of given character per death caused On this basis, we see that it takes 2.4 crossing smashes 20 service accidents, 32.5 collisions, 63 miscalculations with regard to the speed of moving trains, 22 engine mishaps, 71 mischances of the unclassified variety, or 118 derailments, to kill one man.

Saving Coal by Reducing Power Waste

(*Continued from page 245*)

quent loss of efficiency The board, however, furnishes an ever-present check These are only a few instances showing the value of the device.

And the beauty of the scheme is that the man in charge of the board will not even have to watch the readings on the instruments to keep track of things, for it is planned to have an alarm bell and an incandescent lamp with a red bulb under each instrument, as warning signals, which will operate when the temperature, pressure, etc, as the case may be, get beyond prescribed limits

The instruments, which have nickeled cases, are mounted on a beautifully polished marble slab, six feet high by thirteen feet long. They record the following:

Temperature of kitchen hot water, city water pressure; level of water in tanks on roof; temperature of house hot water; temperature of drinking water; high pressure air system (used for turbining boiler tubes, etc); voltmeter (showing speed of exhaust fans on roof); temperature of laundry hot water; pressure of house hot water; pressure of hydraulic elevator; boiler "blow down"; high and low pressure steam returns; ground-floor ventilation-air temperature; boiler feed-water temperature; pressure in annex steam-heating system; outside temperature; steam pressure of boilers; pressure of house heating system; sewer water from ice machines; city water temperature; temperature of low pressure return brine (for ice machines). In addition each of the three ice machines has

Use That Idle Time

YOUR architect may not be busy now—but in a few months he will be! Start him *now* on the plans for your next building, and get the benefit of his unhurried time.

And remember that modern daylighting and natural ventilation involve far more than merely "so many square feet" of sash and ventilators. The basic design of the building itself is more than likely to be involved.

We have had wide experience in fitting LUPTON STEEL SASH PRODUCTS and building plans to each other, and have developed certain methods by which extraordinary results are secured. Wider floor areas, better layouts more uniform and abundant air changes, and better-distributed light result where our recommendations are followed.

This service does not replace your architect or engineer; it merely places at his command a special experience unmatched, we believe, anywhere.

We consider Lupton Service part of the obligation we owe to users of our products, and make no charge for it. But it will be most valuable to you if rendered while the present lull gives time to do your needs justice.

Why not send us your plans or sketches NOW for preliminary suggestions?

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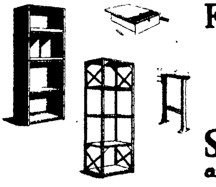

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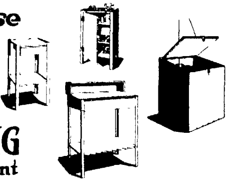

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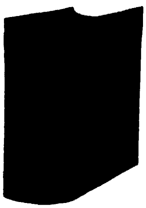

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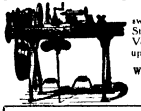

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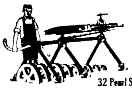

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four instruments: steam pressure in generator coils, temperature of outgoing water, temperature of outgoing brine; pressure of ammonia in the generator.

There is room on the board for about a dozen more instruments Among other additions contemplated are an instrument for measuring the velocity of the wind, which will be valuable in preventing damage to flags etc

Keeping Check on Gas Burner Performance

(*Continued from page 245*)

in pressure caused by this meter air is permitted to flow through the 40-cubic foot gas holder The joint use of these various devices constituting the laboratory test unit is so effective that the air and gas enter the burner at such uniform pressure that fluctuations thereof in the burner are less than one-thousandth of an inch of water pressure

The top of the box shown at the right in the foreground of the illustration, is left open and the burners operate in a normal fashion The pressure in the burner is indicated by a very sensitive slope U-gage, xylene being used in this pressure-recording instrument Minimizing the hazards that otherwise might be caused by explosions in the box attributable to the harnessing of a combustible mixture, a piece of oil paper is pasted on one side of this box This answers the demands for an adequate explosive head

Ultimately this Government bureau should be enabled to indicate to industrial as well as domestic appliance manufacturers scientific methods of procedure in designing gas appliance apparatus To minimize gas consumption by one-half may appear as a fantastic dream but a scientist of the Bureau of Standards thinks that such an ambition is not a remote accomplishment

Phosphates by a New Process

(*Continued from page 245*)

costly losses are entailed in divorcing the impurities from the phosphate material finely divided particles going to waste It is computed that the wastage is twice as great as the volume marketed with mechanical and chemical skill yet failing in its efforts to draw a dividing line between the phosphate and these impurities

Although the commercial practicability of producing phosphoric acid from mine-run phosphates by this new process has not been established the Government authorities are inclined to be prophetic as to the maturity of plans Material in the hard-rock regions of Florida as it occurs in the mines has a composition which is said to be admirably adapted to this furnace treatment Furthermore, instead of necessitating enrichment by supplementing of higher grade phosphate much of it must be brought to the desired composition by the addition of silica or sand, of which there is an abundance throughout the phosphate mining area

If the new process can eliminate the costly operation of washing and screening plants, coupled with the possibility of prolonging the life of the phosphate deposits, the additional expense involved in the preparation of briquets and the use of fuel oil instead of sulfuric acid as a reagent will be more than offset by other advantages According to claims, the concentration of the product gives an advantage of standing the expense of longer shipments than the ordinary phosphoric acid, which contains only from 16 to 18 per cent of the soluble phosphoric acid Combine this concentrated phosphoric acid with ammonia and potash and the highest grade of fertilizers is the result, so say the Government experts

Canada's Superpower Zone

(*Continued from page 246*)

every community, large or small, conditional only upon its being prepared to make a contract with the Commission and to assume the liability that accrues on account of such an undertaking. There is no discrimination The small user buys electricity at the same price charged the large consumer, and there is a standard rate in each locality agreeable to the circumstances that control there The dominating purpose of the Commission is that there shall be an equality of right to power in all areas within range of the current generated in any of its plants The longest transmission distance now spanned by the Ontario Hydroelectric system is 250 miles from Niagara to Windsor, just across the boundary river from Detroit The people of Windsor pay 40 per cent less for their energizing current than the citizens of the far larger Michigan municipality

The territory over which power is now transmitted by the Commission extends from the Ottawa Valley on the east to the Detroit River on the west, and from the shores of Lake Erie and Lake Ontario on the south to the regions north of Lake Superior The latter district, however, is disassociated from the principal field of service The desire of the Commission has been to extend the convenience and the stimulating productive effect of electricity wherever possible and to this end the farm dwellers are being brought more and more within reach of hydroelectric power sources

As is well known, when the general load increases the cost of delivery of current diminishes and on this account the heavier charges for wages and materials since the war have been more than counterbalanced In some cases the credit sheets of the communities show sinking funds nearly equal to the original expenditures for the local plants, and by reason of this it will be possible to extinguish in fifteen years or less debts that were only expected to be wiped out in thirty years Again, where circumstances call for it, the surplusses are being reinvested in bettering or enlarging existing equipment The City of London, in 1917, after paying all charges and keeping its powerhouse, etc, in first class condition had a surplus of $76,000 on an initial investment of $750,000 Because of extensions and improvements this bustling Ontario municipality has a plant today valued at $1,200,000 Over a third of this installation is now free of sinking fund and interest charges and is subject only to maintenance and operating expenses

In the earlier days of hydroelectric development in Ontario, the Commission bought all its supplies from dealers and manufacturers, but as its operations expanded the organization found it expedient and more economical to obtain its lamps and other equipment in large quantities and then to provide the municipalities from this stock, thus enabling the consumers to get these things more cheaply

Perhaps a financial summary will give a more complete idea of what has been achieved in Ontario through this pooling of the public interests for the promotion of a wider employment of hydroelectric energy The installations owned by the Commission, and by which it serves a multiplicity of communities with power and light, represent a cash value of $56,923,000 This includes the erstwhile privately held Ontario Power Company's works The equipment belonging to the various constituent municipalities under the direction of the Commission is worth $24,298,870, making a total of $81,221,870 The administration offices and the buildings for other purposes could not be replaced for less than $1,500,000 The total cost of the Niagara power development is $15,000,000 If, to these fixed assets, be added the value of materials and supplies on hand, securities, interest-bearing investments, sinking fund deposits, etc., the combined monetary strength of the Commission can be put at $106,000,000.

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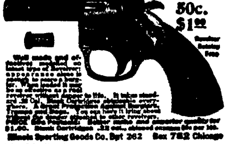

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Relativity and a Rotating Disk

(*Continued from page 247*)

to be either negligible or somehow compensated in the above ideal exposition. Existence of such strains, however, would leave the fundamentals of the problem unchanged.

Now suppose that before the disk had been set in rotation, *A* made scratches on the surface of the disk at the ends of each of the measuring rods which he has set out. If he uses the distance between each pair of adjacent scratches as his unit of *length*, the ratio of circumference to radius must of necessity be 2π, no matter whether the disk is at rest or in rotation. This method of measurement gives him a Euclidean geometry under all conditions. Now suppose the first hypothesis of the last paragraph to be true Then when the disk is in rotation, the distance between two scratches along the periphery, as observed by *B*, will agree with *B*'s unit of length The contraction of the special theory will be absent However, the measuring rods set out by *A* along the circumference of the disk will not quite reach from scratch to scratch Obviously, the disk may be made of the same material as the measuring rods. The latter, not being under constraint, have contracted as compared to the distance between scratches on the edge of the disk Hence the disk must be under tension around the circumference If a slit is cut along a radius of the disk from center to edge, then when the disk is set into rotation this slit will grow into a gap which will become wider the greater the speed However, the gap will be exceedingly small under any conditions realizable experimentally For instance, at the edge of a disk ten feet in radius rotating at the prodigious speed of a thousand revolutions a second, it would have a width of about a millionth of an inch These conclusions, of course, are based on the assumption that the radius of the disk, as measured by *B*, is unaffected by the rotation The phenomena taking place if the radius should change can easily be worked out by the reader Examination of the problem brings out the important fact that the character of measured space is dependent on the method of measurement employed One convention regarding units of length leads to the conclusion that a certain region of space is non-Euclidean, while another gives the same region a Euclidean character.

Watermarking Hand-Made Paper

(*Continued from page 248*)

by the King of Italy, The Pope and were used by the late Theodore Roosevelt and Elbert Hubbard. Ex-Kaiser Wilhelm also used correspondence paper with his watermarked portrait before his downfall

The first colored watermarks were made in England about thirty five years ago but have been carried to a greater degree of perfection by the continental paper-makers Each sheet is made in two thin layers and between them is placed a third layer in the form of a design in any color. The lettering or design is produced by using a stencil placed over the mold and cut in the form of the lettering As many colors as desired can be inserted between the two layers of wet pulp but each *color must be formed separately*. The lettering so formed is only visible when the sheet is held to the light. Non-running dyes are used so the design will not spread its color over the two outside sheets which are white in most instances. Owing to the skill and time required in making colored watermarks they are used only in the most expensive and elaborate papers.

There is not much similarity between a watermarked paper produced on a hand-mold and one made by the dandy-roll of a paper machine. In the former the wet pulp lays over the design on the mold during the entire making of the sheet of paper, while in a machine-made sheet the mark is pressed into the wet pulp from above after the sheet in the wet state has been completely formed

For making a watermark in machine-made paper the design is soldered to a large brass skeleton roll the width of the paper machine and is called a "dandy-roll" This cylinder, supported at each end by an axle, revolves upon the surface of the pulp and imparts to the fibrous pulp the design attached to its surface as well as the laid lines of which the skeleton roll is composed Therefore all laid papers *made on a paper-machine* are an imitation of the laid lines of a hand-mold as the natural finish of a machine-made sheet of paper is wove

It is the pulp laying constantly over the watermark design on the surface of the hand-mold during the entire operation of forming a sheet that gives it the superior qualities and sharpness of line. In this way the pulp is held in different thicknesses to conform to the applied wire watermark while in the dandy-roll watermark of the paper-machine the design or form is simply pressed into the wet sheet from above which pushes the fibers aside and therefore a sharp and distinct watermark, like the mark in a sheet of hand-made paper, is not possible

Putting Rejected Oranges to Work

(*Continued from page 250*)

From the filter the juice is conveyed in glass lined pipes to the cooking department where it is mixed with a uniform quantity of sugar, and the individual lots are cooked to a uniform consistency by expert women cooks A small part of the very best fruit is selected and choice strips of peel are taken off from the center of the fruit and run through a special device known as a shredding machine, which chops the strips of peel into very fine shred This raw shred is then put in a steam cooker and cooked until it becomes very tender The water is then pressed off and the dry cooked shred is added to the marmalade before it reaches the finished point, and this shred adds the flavor of the peel as well as gives a delicate body to the finished marmalade

After the pans of marmalade have reached the finishing point they are immediately removed from the cooking table and the marmalade is emptied into a large enameled tank, which supplies the filling machine On one side of the filling machine is the glass washing machine, where the empty glass is carried through a bath of hot water and live steam, and delivered to the filling machine sterile and dry for immediate filling

After leaving the filling machine the glass is passed over an inspection table, where *each glass is candled* by a woman inspector, and at this point any jars containing thick or scorched shred or other discolorations are removed, and the inspector places on the glasses, that pass inspection, the cap. The glass and cap are taken off the belt by the capping machine operator and the caps are automatically sealed down after a 25-inch vacuum has been exhausted under it

From the capping machine the glass is conveyed to the labeling machine, where the labels are put on mechanically, and from the labeling machine the packages are conveyed to the packing table, where *they are packed and prepared for shipment*

Cull lemons are utilized, principally, in the manufacture of citric acid, although orange and lemon oils are extracted from the peel and used for food and medicinal purposes. In 1919 the Exchange Orange Products Company handled 18,000 tons of lemons not suitable for Eastern shipment Practically all of this quantity of fruit was converted into citric acid and citrate of lime in the company's own plants.

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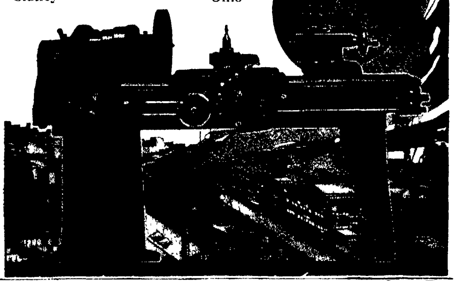

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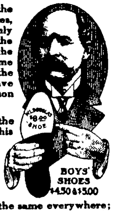

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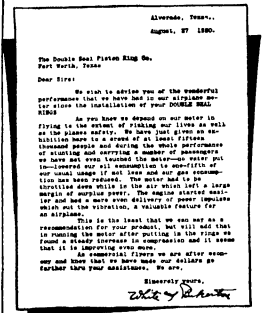

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sible juice, from which the acid is made, and the refuse and pulp is removed to storage bins, later to be used as fertilizer on the orange groves of the members.

The juice from the press is pumped into large storage tanks and held until passed to the boilers The juice is clarified by filtering and is then boiled with a solution of lime and chalk This process neutralizes the juice and results in the formation of calcium citrate The calcium citrate is separated from the neutralized juice by means of a filter press, and by adding sulfuric acid the juice forms a weak solution of citric acid, which is then converted into a strong crude citric acid liquid by boiling under vacuum in a vacuum pan From these vacuum pans the crude citric acid liquid is pumped into the first crystallization pans, where it forms, when cool, a thick black mass. This mass is then redissolved and all impurities taken out, and again boiled under vacuum to the point of crystallization. While still in liquid form it is pumped into shallow pans to cool, and when cool it appears in pure white crystals The material is then transported, by means of dump cars, to the centrifugal machine, where the crystals are thoroughly washed, dried and all impurities removed The citric acid crystals are then graded according to size and are packed in barrels ready for shipment

Another product made from cull lemons is lemon oil of which the world consumes annually more than a million and a half pounds, and about half a million pounds of oil secured from orange peelings It is hoped to supply a large share of the American demands from the byproducts plants operated in southern California Lemon oil made from frozen lemons was sold to a large confectioner who reported that the results secured with it were fully as good as with the imported product previously used, and he agreed to take all that could be produced at the experimental plant

Practically all of the citrus oils used in this country are imported from Italy, being produced there by hand In the California laboratories the *problem* is not only to produce oils of equal quality with the imported, but to devise means for doing the work by machinery On account of the high wage scale in this country it would be impossible to compete with Italy under the hand method, and as a first step in doing this work mechanically a new machine has been invented by one of the government chemists to peel the citrus fruit

The method of extracting orange or lemon oil used in Italy, Sicily and other parts of southern Europe is to peel the fruit by hand, either cutting it in half crosswise and scooping out the pulp or by stripping off the peel in three longitudinal pieces. The peel thus secured is inverted and pressed over a small sponge. By this means the oil cells of the outer part of the peel are ruptured and the mixture of oil and other liquids is forced out in a tiny spray After the sponge has become saturated, the contents are squeezed into a bowl, and the oil is eventually drained off the accumulated liquid.

Through a thorough utilization of all the fruit grown on the citrus groves of California, the industry will be stabilized and the consumer of perfect fruit will not have to bear the entire cost of the crop, for all classes and grades of fruit will have a distinct value.

Using the Vacuum Tube So That the Deaf May Hear

(*Continued from page 251*)

sensitive microphone or transmitter, as distinguished from a highly sensitive instrument which would pick up all kinds of parasitic sounds; a small vacuum tube, transformer, filament rheostat, filament battery consisting of a standard dry cell, a high-voltage battery comprising 16 cells with a potential of 24 volts, and a pair of telephone receivers. The volume of sound is governed at will by regulating the filament rheostat. Despite the employment of an insensitive microphone, the device is extremely sensitive and amplifies any desired sounds because of the amplifying properties of the vacuum tube It is claimed that this device enables persons afflicted with deafness to obtain better results than have heretofore been secured over the ordinary telephone.

No doubt Mr. Hanson will be recalled as the inventor of the radio cable which enables ships to pick their course by intercepting electromagnetic waves emanating from a submarine cable. His present device was developed largely through the facilities extended by the Volta Bureau of Washington, D. C. This institution was endowed by Dr. Alexander Graham Bell for conducting research work to prevent deafness and to aid those who are hard of hearing.

Making Barrels Out of Paper

(*Continued from page 251*)

two halves of the mandrel draw away from each other, each carrying its strip of paper along Thus the proper length of winding is obtained for the height of the barrel being made. After the requisite number of turns have been made to gain thickness, the slitting wheel is thrown out of action and the paper becomes a single strip again, winding several layers on the center of the barrel, to form the bilge. The paper strip is then cut, the mandrel parts separated still more, and the finished barrel removed The entire operation requires less than one minute

Silicate of soda, commonly called water glass, is used as the adhesive. It sets quite rapidly so that the barrels are ready for use shortly after leaving the machine The paper employed is chip board paper, which comes in rolls A wooden head may be employed to finish the barrel, or, if desired, special pressed steep ends may be used The finished barrel is light, strong and clean. It is tight. However, as to cost the paper barrel is not so cheap as the ordinary slack or tongue-and-grooved wooden barrel, due to the high cost of chip board paper at present There is no neater container than the paper barrel, and it is ready to stand the same kind of handling as the usual wooden barrel

Combined Tire and Caterpillar Tank

(*Continued from page 251*)

speeds equal to that of the motor truck

It will be remembered that when tanks were used in the great war, everything possible was done to secure one of their greatest assets, that of surprise. But it was not always possible to make surprise attacks because of the delay in concentrating the tanks, which had to be hauled to the concentration point either on rail road cars or motor trucks The object aimed at in the new tank herewith illustrated is to secure greatly improved mobility, and it is believed that this has been achieved, since they can run on the roads on wheels, and thereby be capable of the quick concentration which is necessary to carry out an attack unexpected by the enemy

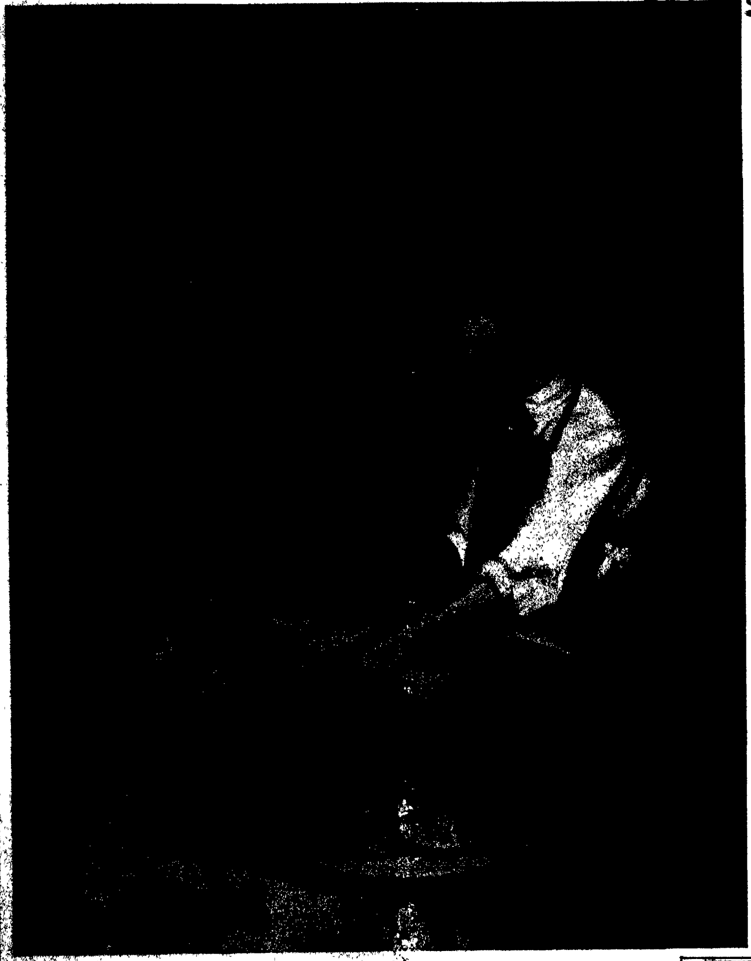
The war has proved that men can be trained more quickly than the ordnance material required to arm them can be produced, and the problem of the Ordnance Department is to stimulate interest in the design and production of war munitions. In accordance with that policy, this particular tank is being built by private manufacture, in coöperation with the Ordnance Department. Excellent work is being done along this line by the Army Ordnance Association, an organization of civilians and army officers who were largely responsible for the production of arms during the war. The Society of Automotive Engineers has a special committee whose purpose is to consult with the Ordnance Department.

IN THIS ISSUE: MAKING THE MOST OF NIAGARA
THE WHY OF LUMINOUS PAINTS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in
INDUSTRY · SCIENCE · INVENTION · MECHANICS

5 MAY 1921



TAKING THE DENTS OUT OF DAMAGED BRASS INSTRUMENTS. —[See page 270]

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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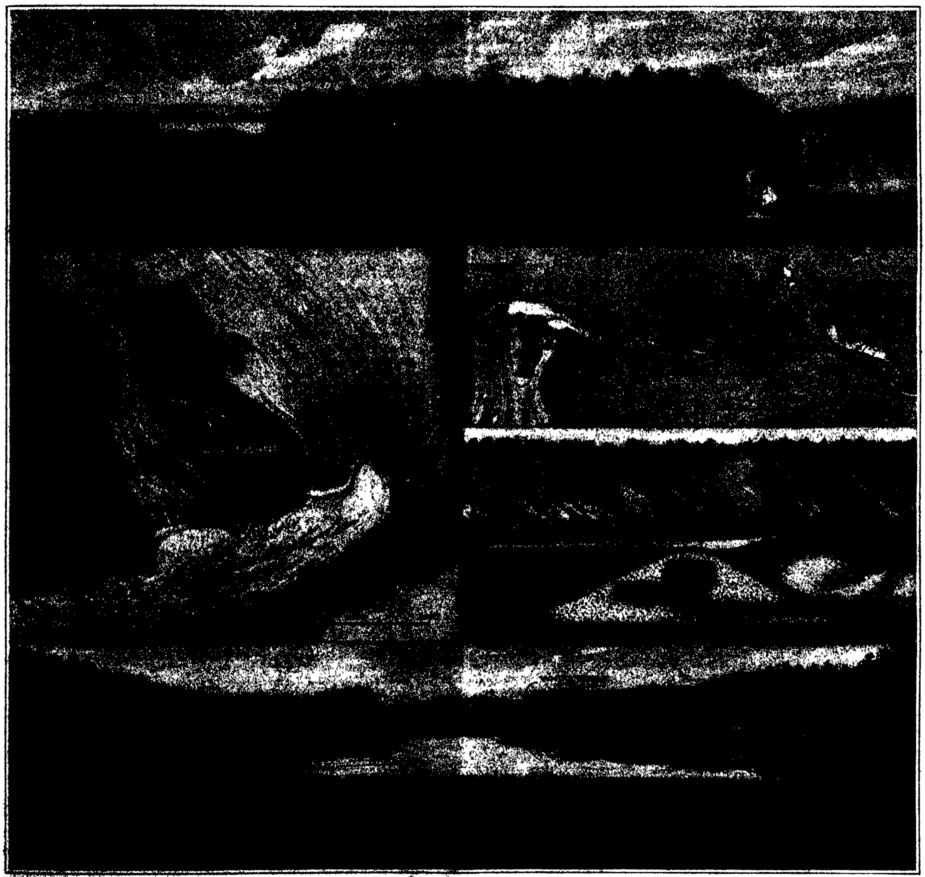

THE PROPOSED HYDRO-ELECTRIC DEVELOPMENTS ON THE NIAGARA RIVER AT GOAT ISLAND AND FOSTER'S FLATS BY WHICH IT WILL BE POSSIBLE TO GENERATE 3,500,000 HORSEPOWER.—(See page 266)

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A Call for the Automatic Stop

ONCE more has a collision between passenger trains resulting in a shocking loss of life emphasized the necessity for the introduction of the automatic stop in the operation of railroads It is the too-familiar story of the failure of the human element. The stage setting of this tragedy at Porter, Indiana, consisted in a level crossing of two main lines, each carrying a fast-passenger service, and a well-thought out system of block signals functioning with accuracy; and the tragic action consisted in the failure of the engine-man of one train to observe and obey certain signals which were set against him, with the result that thirty-seven people were killed and twenty injured.

Had the automatic stop been installed, the Michigan Central train would have been brought to a stop before reaching the crossing, in spite of the failure of the engineer to apply the brakes. The automatic stop, as such, long ago passed from the stage of the experimental to the class of the well-tried and widely approved invention. The supreme achievement of the automatic stop has been made in its use for several years in the New York subway systems, where millions of passengers have been carried at express speed under a headway of less than two minutes without the loss of a single life as the result of collision. We have never been able to find any reason why the automatic stop, with proper modifications and safeguards, should not be equally effective when used in the open on the trunk lines of this country We say this with full appreciation of the fact that in the subways the stop is working under ideal conditions, free from rain, snow or ice There are excellent open-air automatic stops available Their application on such important crossings as this at Porter, Indiana, should be made obligatory

But if legislation is enacted it should not be too sweeping Universal use, just now, is impossible—the cost would be prohibitive A bill should be drawn, covering all dangerous points that are subject to unusually heavy express service.

Do You Want an Airship?

GOVERNMENTS have at various times made gifts of considerable magnitude, but we doubt if there is any precedent for the giving away of fifteen million dollars' worth of highly developed and up-to-date war material. We refer to a cable dispatch announcing that the British Government is offering its fleet of large airships to any syndicate that will undertake to operate and experiment with them; the only condition imposed being that in return, all the data and useful knowledge acquired by such operation shall be at the disposal of the Government Among these craft are the airship "R-36," somewhat larger but practically a sister ship to "R-34" which last year made a round voyage across the Atlantic to Mineola and back. "R-36," which has just made her maiden trip, has been adapted for passenger service and differs from "R-34" by being thirty feet longer and having a combined horsepower for her five-power gondolas of 1,570 horsepower, as against 1,250 horsepower developed by "R-34" In addition to this ship there are two others of the latest British-built airships, namely, "R-33" and "R-37," and also "R-32" and "R-80," vessels of a smaller rigid type To these are to be added two huge airships surrendered by the Germans and known as "L-64" and "L-71." The total value of the fleet which is now offered as a gift is about fifteen million dollars.

Although the surrender of these vessels will be a serious blow to the naval service, the striking of them from the list by no means represents a total loss to the nation. If syndicates are formed with sufficient backing to take the vessels over and operate them in a mixed passenger and light package service, they may still be counted as a national asset. Indeed, in view of the necessity for severe retrenchment in naval and military expenditures, it is probable that the art of airship construction and operation will be promoted instead of hindered by the proposed transfer. In England, as in this country, private interests have been clamoring for government assistance. They have now received that assistance in a very tangible form, and the future development of lighter-than-air commercial aviation in Great Britain will be followed in the aeronautical world with the keenest interest.

The Hydrographic Office

THERE is no branch of naval activity in which greater efficiency has been shown or such valuable results obtained for a relatively small outlay, as in the Hydrographic Office of the United States Navy. It is not a large institution in point of numbers, and the total appropriation asked for this year is considerably less than one million dollars; but its work in aid of the navigator is known and appreciated on every ship, naval or merchant marine, that sails the high seas.

No better general description of the work of this office can be found than that contained in the Act of Congress by which, in the year 1866, this institution was established. It is described therein as "a Hydrographic Office for the improvement of the means for navigating safely the vessels of the Navy and mercantile marines by providing, under the authority of the Secretary of the Navy, cheap nautical charts, sailing directions for navigators and manuals of instruction for the use of all vessels of the United States and for the benefit and use of navigators generally."

But, in spite of the fact that the Hydrographic Office has been giving most efficient service for over half a century, it is now proposed to remove this work from the Navy Department and incorporate the office with the Coast and Geodetic Survey under the Department of Commerce. Now we all are in sympathy, or ought to be, with the present movement in the direction of reorganizing the administrative machinery of the Government by consolidating certain sections of its activities, thereby cutting out needless duplication and expense. The broad principle is a good one, but, like all other broad principles, it should be applied with discretion, and careful attention should be given to every individual problem before amalgamation is carried out. The Hydrographic Office is a case in point, and the proposal to amalgamate it with the Coast and Geodetic Survey, thereby taking a highly specialized branch of naval work away from naval men and putting it in the hands of civilians, who may or may not know anything whatever about the sea, could only lead to the work being less efficiently done, and probably at greater cost.

The provision of suitable charts and sailing instructions and the gathering of the large amount of miscellaneous information which is so eagerly sought and greatly valued by men who sail our ships, both naval and mercantile, to and fro upon the ocean highways, is essentially a naval job and the effective use of the Navy itself depends upon the possession of an adequate number of thoroughly reliable charts. Without them, should we be at war, our naval operations in distant parts of the world would be most seriously hampered. In this fact alone is to be found a sufficient explanation of the care which the Hydrographic Office devotes to its work, and we are satisfied that everyone who reads the article entitled "Twelve Hundred Charts at One-third of a Cent," which we publish elsewhere in this issue, will agree with us that we should let well enough alone and not transfer this important work from a highly organized and very efficient institution to one which in the very nature of things is not so well qualified for the job.

The Coast and Geodetic Survey covers not only the coast line but also the whole interior of the United States. There is yet another institution known as the Geologic Survey, which also is engaged in a survey of the interior. Obviously, if amalgamation is to be made, the logical step would be to combine the Geodetic Survey with the Geologic Survey and combine the Coast Survey, which is more a nautical than a land job, with the work of the Hydrographic Office. If amalgamation is what Congress seeks, here is one that might be carried out to very good effect and result in considerable all-around economy.

Summer Resorts and Water Supply

THE fight of the property owners and summer residents at Lake Hopatcong to prevent a group of Jersey City politicians from destroying the Lake as a summer resort will meet with a sympathetic response from those of us who appreciate the charm and restorative qualities of our lakes and mountain summer resorts. The proposal to divert the waters of Lake Hopatcong for the portable uses of Jersey City carries with it the imposition of restrictions which would prevent the use of the Lake for boating, bathing, fishing and so forth,

The right of condemnation of lands in the drainage area of lakes and reservoirs which are used for water supply is a good principle when it is applied to very sparsely settled areas, as in the case where new reservoirs are being built on sites far removed from centers of population. But if this principle be applied to bodies of water which, because they have never been considered likely sources of supply of potable water, have passed into the hands of thousands of private owners and have become the site of flourishing communities, a great injustice will be done. Moreover, the purification of drinking water on a large scale has become so simple and inexpensive a matter that the occupation of the shores of such bodies of water as Lake Hopatcong, Greenwood Lake and others by summer residents has ceased to be a risk to the public health. This fact is recognized in a letter from the Chief of the Division of Geology and Waters, Department of Conservation and Development of New Jersey, to one of the leading residents at Lake Hopatcong, in which he states his belief that it is impracticable and inadvisable to depopulate the watersheds of northern New Jersey, even where they are used as sources of supply. He makes the further statement that, in the future, only a relatively small part of the State's population can enjoy the expensive luxury of pure, raw water, drawn from uninhabited collecting grounds. It is certain he states that, increasingly, all surface supplies must be purified before they are used by the public.

Secretary Hoover on Food Research

IT comes with a shock of surprise to learn from Secretary Hoover that the United States must some time in the future pass from a food-exporting to a food-importing nation. The Secretary says this in a statement which he recently issued on the work to be done at the Food Research Institute which has been established at his suggestion in Stanford University and by the Carnegie Corporation. The new Institute will make a study of food distribution systems, the chemistry of manufacturing processes, and of production and agriculture. Milk and other commodities are to be traced and charts of costs, consumption and other data are to be compiled. The work of the Institute will be world-wide in its scope. Food-exporting areas of the world will be classified on the basis of their relations to our production and consumption, and to world trade. The question of transportation to and from each country will be analyzed and tabulated.

We regard this as one of the most important movements that has grown out of the experience of the World War and the terrible years that have followed. The work of the Institute, as thus outlined, will form one of the important agencies in the work of reorganization and reconstruction. It is understood that Mr. Hoover, who is a graduate of Stanford University and one of its trustees, will serve as a member of the Advisory Committee.

The Carnegie Corporation will provide 700,000 dollars for the support of the Institute for a period of ten years. The University will make its scientific laboratories available to the Institute, which will be careful not to duplicate equipment of research laboratories which are already working in the field of nutrition, but will endeavor to cooperate with all other agencies.

Naval and Merchant Marine

A Record Feat of Bunkering.—A new high record for rapid coaling of ships is reported by the Superintendent of Coaling Plants at the Cristobal coaling station, Panama Canal. The steamship "Pakeha" was coaled on December 24, 1920, with 1,002 tons, in one hour and ten minutes. So far as we know, this is the world's record.

The Present Shipping Situation.—It is estimated by Gordon Robinson, Editor of *Fairplay*, that thirty per cent of the world's tonnage is now out of employment, or 17,000,000 gross tons out of the 56,800,000 gross tons afloat at the first of this year. Every country is affected, including ourselves. It is estimated by E. S. Gregg that about one-half of the Shipping Board's 6,900,000 gross tons of steel tonnage is idle or awaiting assignment.

Shall We See the 20-inch Gun?—The tendency to mount naval guns of increasing caliber and caliber-length shows no signs of diminishing. We have gone from the 12-inch to the 14-inch and now to the 16-inch gun, the British built and actually used an 18-inch gun in the war, and in spite of the enormous increase in individual displacement of ships resulting largely from these heavy calibers, no one seems disposed to call a halt.

"Olympic" as an Oil Burner.—Since the "Olympic" was equipped as an oil burning ship, she has undergone enlargement of her tank capacity. Last year it amounted to 5,068 tons. She has now a capacity for 7,555 tons of oil. The one-way consumption of oil, taken as an average over a period of voyages, is nearly 3,000 tons a voyage. The conversion to oil released about one thousand tons of space for cargo in the old bunkers, and other space has been used for pump rooms, et cetera.

Volume Versus Weight of Fire.—The "Tennessee" and the "Maryland" are of about the same displacement. One mounts twelve 14-inch guns, the other eight 16-inch guns. Since it is the shots that hit that count, the "Tennessee" with equal gunnery should make fifty per cent more hits than the "Maryland." Since she has equal speed, she could hold a range to suit her lighter gun. Would the heavier burst of a 16-inch shell outmatch the lighter burst of fifty per cent more hits by the 14-inch gun? Personally, we think not.

Submarines Cannot Sink Battleships.—Unless a battleship is traveling alone and unattended, something she should never do, she cannot be sunk by submarines. The late war proved this to a demonstration, for although the Grand Fleet was continually out in the submarine-infested North Sea not a single battleship of the vast fleet was put down by submarine attack. The Germans were fighting a war of attrition; we may be sure that the submarines used every artifice to get at the battleships of the Grand Fleet. They were thwarted by the screen of destroyers.

The World's Construction of Ships.—The latest figures given out by Lloyd's show that in spite of the present depression in the ship carrying trade, there are over seven million tons of shipping being constructed throughout the world. This is made up of 921 ships representing a gross tonnage of 3,708,916 which are being built in the United Kingdom and of 1,059 ships of a combined gross tonnage of 3,470,862, which are being built by all the other countries of the world. The last figures do not include Germany, for which no statistics are as yet available.

Indirect Fire for Naval Guns.—In the *United States Naval Institute* for February, Commander D. C. Bingham states that the subject of "indirect fire" afloat is one of increasing and urgent importance, and is deserving of the greatest consideration by those concerned with progress in ordnance material, gunnery and tactics. He states that the destruction of the "Koenigsberg" in South Africa, the firing of the allied ships in the Dardenelles, the work of the monitors of the Dover Patrol, and the low visibility conditions in the North Sea have strongly emphasized the importance of this subject.

Early Hand-Power-Driven Naval Ships.—Eng.-Com. E. C. Smith, in a lecture recently given at Devonport, stated that the first power-driven ships of the navy were propelled by hand-worked paddlewheels. The 46-gun "Active" was thus operated at a speed of between two and three knots, by two paddles actuated by the turning of a capstan. Another small frigate was driven by paddles which were turned by means of winches. In this case the speed was three knots. The *Naval and Military Gazette* tells us that, in spite of the hard work entailed, the seamen favored this auxiliary machinery because it enabled them to get into harbor when the wind failed.

Science

Leonardo's Airship.—The Division of Mechanical Technology of the United States National Museum has constructed and placed on exhibition a model of the flying machine designed and constructed in 1490 by Leonardo da Vinci. The model has been adversely criticised.

Weatherproofing Plymouth Rock.—This much-abused boulder, which has recently had its fragments united, is now being preserved against the elements. Even rock can be weatherproofed by chemical means, as in the case of the obelisk in Central Park, New York.

France's Population to Recover in Seventy Years.—Dr. Richard P. Strong of Harvard, lecturing at Johns Hopkins University, states that it will require seventy years for France to recover her loss in population brought about by the war. Dr. Strong places the entire loss of life at 43,000,000 for all countries and the total cost of the war $348,000,000,000. Dr. Strong probably does not exaggerate but the totals are staggering.

Swiss Glaciers Running Thin.—The drought in Switzerland is very unusual and is disturbing the economic balance, for navigation on the lakes is almost suspended and the cattle have to be driven long distances to obtain water. Many glaciers have broken and the moraines or "glacier terminals" are far up the mountains. There is less snow now on the peaks than in the normal August when mountain climbing is at its apogee.

Return of the Non-Magnet Ship.—The non-magnet ship "Carnegie" has reached San Francisco after having, as it were, completed an X-ray of the earth. Many of the best charts will have to be amended as the result of this voyage on a ship where even a steel hair spring in a watch is taboo. The "Carnegie" has traveled more than 300,000 miles since 1909. This gift of the kindly iron master has proved a treasure house of scientific research.

Cost of M. D.'s Goes Up.—It costs in the year of grace 1921, the sum of $4,600 to make a doctor and when he receives his sheepskin, which is a preliminary to the shingle, he has paid only $1,280 toward his education, the medical college paying $3,320 for the balance. Everything connected with medical education has advanced to such a point that if the schools were not heavily endowed, they would have to curtail their activities materially.

Gorgas Memorial Institute.—Researches in tropical medicine will be carried on by the Gorgas Memorial Institute in Panama and eventually a building will be built adjoining the Santo Tomas Hospital in Panama, with a statue of the great sanitarian in front. Three American physicians holding official positions will be sent, one a medical officer of the army, one from the navy and one from the United States Public Health Service. Assistance will be given by other institutions of tropical medicine all over the world.

The Calama Solar Station.—The Smithsonian Institution announces that its solar radiation station in Chile has been moved from Calama to a mountain 10 miles south of that place, where skies of extraordinary purity have been experienced. Telegraphic reports of observations which for the past two years have been sent to the Argentine meteorological service for use in connection with weather forecasting, are now also sent to the Brazilian meteorological service for the same purpose.

Again a Cure for Seasickness.—Remedies for seasickness come annually with the spring flowers but Professor Nolf of the University of Liege claims to have discovered a uniformly successful one in the shape of a milligram of sulphate of atropa on going on board, and additional doses of half this strength at intervals of half an hour. The professor does not explain how it affects the pneumogastric nerve, but it evidently does if we give credence to the excellent reports. Seasickness itself by-the-bye is supposed to be caused by a movement of the liquids of the internal ear which seems to affect the pneumogastoric nerve.

Robert Louis Stevenson as a Meteorologist.—The Stevenson family were lighthouse builders like the late F. Hopkinson Smith. Meteorology is a necessary science for the lighthouse builder to master. When he was 21 years old, the young Scottish novelist received a silver medal for a pamphlet on lighthouse illumination. This was followed by two papers on meteorology contributed to the Scottish Meteorological Society and the Royal Society of Edinburgh. The former society has just been merged with the Royal Meteorological Society of England, for Scotland is fast merging into England, "North Britain" being the first step to the dis-establishment of many things.

Aeronautics

The Lawson "Midnight" Air Liner has been designed and constructed by the Lawson Airplane Company of Milwaukee, Wis. It has been built especially for night service. The cabin is 65 feet long and the wing spread is 120 feet. It has three Liberty engines aggregating 1,200 horsepower. The speed of this machine is said to be from 120 to 125 miles an hour and it can fly at a height of 25,000 feet. These figures are remarkable, it goes without saying. Sufficient fuel is carried for a 15-hour flight.

Duration Record.—At present the world's duration record stands at a little over a complete day—24 hours 19 minutes 7 seconds, to be exact—the performance standing to the credit of the Farman "Goliath." It may not stay there long, however, as a new Farman "Goliath" has been built with a view to making a continuous flight for 35 hours, according to *Flight*. Speaking of duration records, it will be remembered that Lieutenant Kilpatrick of the United States Army recently made a flight of 18 hours 5 minutes in a Curtiss "Eagle," being forced to land owing to a leak in one of the petrol tanks.

Greater Lift from the Wings.—The Glenn L. Martin Company of Cleveland, Ohio, has lately designed an airplane wing which can lift a greater weight per square foot than any other known wing, according to their claims. At 30 miles per hour speed, a model only 18 by 3 inches in size carried 14¾ pounds per square foot. This is twice as great as the lift of the famous "R A F" 15 wing, and 25 per cent more than that of the Handley Page high-lift wing, according to the only record published. The efficiency of the Glenn L. Martin new high-lift wing at high speeds is 10 to 15 per cent greater than the highest value ever recorded for any wing except the Parker variable camber airfoil. Again, it can not only carry great loads on planes of small dimensions, but for racing machines it is at the present time unequaled, according to the designers.

Steam Motors for Aircraft.—A short discussion of the lines along which experiment and development will have to be made, with reference to the present research of Germany and England on this subject, is contained in a recent issue of *Aviation*. The use of high pressure steam is advocated, and the single-acting type of steam engine is recommended, owing to its absence of stuffing boxes, and simplified valve gear. The three-cylinder radial single-acting engine with variable cut-off, cam-operated, is stated to offer the most promise. Estimates are given showing that a 200 horsepower engine at 900 revolutions per minute, using 500 pounds pressure steam, should not weigh more than 400 pounds, the condenser weighing 100 pounds. This engine would require 14 pounds of water per horsepower hour and 1¼ pounds of liquid fuel.

Aerial Agreement Between Great Britain and France.—The text of an agreement between Great Britain and France regarding aerial navigation has recently been published in the *Official Gazette*. This agreement will cease to be in force as soon as the International Convention for aerial navigation drawn up by the Peace Conference becomes effective. The agreement provides that the two governments will permit the free passage of private and commercial aircraft while reserving the right to establish prohibited areas for military reasons. All aircraft must carry a log and a traffic permit. The pilots must have a certificate showing their qualifications. The use of wireless apparatus without special permission is forbidden. The respective authorities reserve to themselves the right of examining aircraft on arrival and departure.

Speaking of Short-Lived Airplanes.—We have come to consider the airplane as a frail piece of work, which lasts but a few months when subjected to regular use. That may be so in the case of most airplanes, but there has been recently brought to our attention the story of a British seaplane of the Fairey type. Designed in 1916 as a seaplane, this machine was delivered to the R. N. A. S. in April, 1917. This seaplane was in service till after the armistice. In May, 1919, this machine was brought back to England as a "Disposal" machine, being used to carry newspapers from Blackfriars to Thanet. During the summer of 1919 this seaplane was employed for experimental work. September, 1919, saw this same seaplane flown in the Schneider Cup Race, and it had the honor of being the only competitor to return intact under her own power. During the early part of 1920 this machine was used with amphibian undercarriages. Since then it has been used for ferry work between Southampton and Sheerness. In all, nine engines have been used to a finish for the power plant of this seaplane.

Twelve Hundred Charts at a Third of a Cent

A Few Words About a Necessary Expenditure for Which Congress Has Failed to Provide

By C. H. Claudy

WHETHER the purpose of a navy is to fight or to prevent a fight may be open to discussion But it is not open to discussion, whether a navy which has to stay at home can either fight or prevent a fight in foreign waters

A navy is composed largely of ships The ships carry guns and the guns must have ammunition and men to man, aim and fire them But all the ships and all the guns and all the ammunition and all the men our navy possesses could not be applied to any war or war-prevention purpose, if the ships could not carry the guns and men and ammunition to the place where the trouble was or was to be prevented

A ship cannot go in unknown waters without a chart, except at the risk of its total loss A lost ship cannot fight or prevent a fight It is evident, then, that as between a warship without charts or no ship at all, there is little choice, so far as action is concerned

The United States has three sources of charts One is the Hydrographic Office of the Navy The second is the Coast and Geodetic Survey The third is the world's supply of charts, as issued by foreign hydrographers Of these, the British Admiralty is the largest and most important source

Between Great Britain and the United States there exist the most cordial and friendly relations hydrographically We use the British charts and they use ours We take their charts copy them, add to them correct them, reissue them They do the same with our charts The world is a big place to go over with a sounding line, and the less such work has to be duplicated the more can be done It is not only the navy which uses charts, but each and every ship that floats The more charts, the better charts, the more easily accessible charts, the more ships can go to the more places and the less is the loss incidental to commerce

At the present moment, the charts of Alaskan waters are sadly incomplete Alaska has an enormous coast line much of which is either uncharted or but little charted Yet so great is the shipping need, and so far has commerce outrun charting in these waters that maritime interests willingly take the risk of sending vessels into these uncharted waters, rather than forego the profits of such voyages. Of course, *some one* pays the bill of lost or damaged ships, and that some one in this case is the American people, who are hardly in a position to realize that one lost ship is more expensive than all the charts necessary to give her a safe voyage

It is to many unthinkable that this country should ever have a serious difference of opinion with Great Britain To most thinking Americans it is equally difficult to believe that any discussions we may have with Japan or Russia or the Fiji Islands or China should require a war to decide

But wars have happened, and we have fought them And if, for any reason, Great Britain happened to be neutral in such a discussion in which we took a leading part, or if she, for any reason, felt it inadvisable to continue the present cordial and friendly relations which exist between her and our Hydrographic Office, we might well find ourselves in the impossible position of having a navy which couldn't go abroad for our interests, because we had not the charts which would enable us to go

During the war the United States ordered charts from Great Britain in large numbers Most of them were received; one case of a thousand charts was lost and never did turn up It took on an average, three months to get them, often longer; and even then, if we were to reproduce them, the time would be greatly extended So that if we had another war with any power in any part of the world, we would still be dependent upon our own supplies, or have to face the need of waiting until British charts could be obtained It is not so much a question of being dependent upon Great Britain's good will as upon being dependent upon the natural limitations of time to manufacture, and to ship And a war does not wait for a belligerent to get ready It strikes as suddenly and with the opponent as much unprepared as possible.

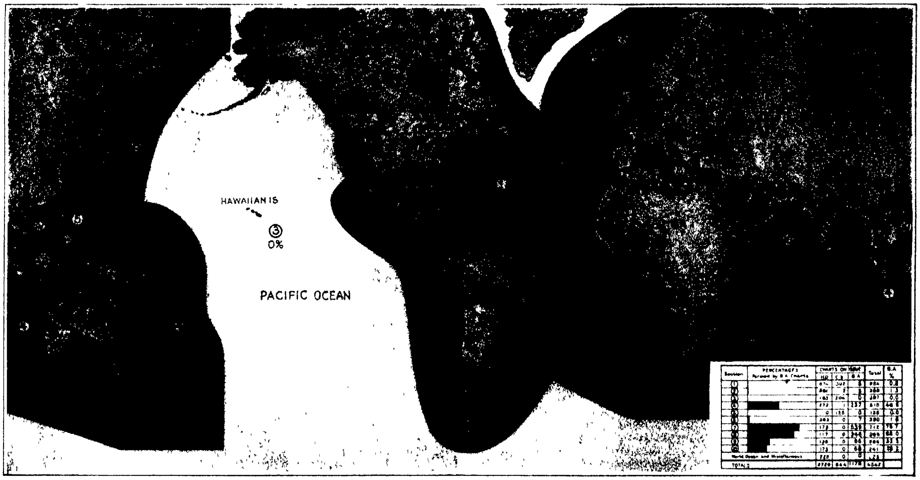
At the present time the Hydrographic Office is twelve hundred plates behind a complete stock of British Admiralty charts. To obtain these plates from the existing charts will require, with the present printing plant of the Hydrographic Office, five years of time and the ridiculously small appropriation of sixty thousand dollars a year—a total of three hundred thousand dollars. This amounts to something less than a third of a cent, spread over five years, for each one of our hundred and eight millions. If the three hundred thousand dollars is not forthcoming at the present rate of progress, it will require forty years to become independent of Great Britain for charts.

The amount needed is so small, and the object to be gained so large that it would seem almost unbelievable that Congress should hesitate for a moment to appropriate it. But the gentlemen who make the laws are not naval men, many of them never saw a battleship or a chart, and have no knowledge of the relations of one to the other A very able American once brought a large amount of ridicule upon himself by his oratorical reference to the million men who would "spring to arms overnight" in the event of an emergency. The ridicule came, not from the thought of the patriotism of our young manhood, but from the fact that they possessed no arms to which to spring. In the event of trouble to be started or stopped, the navy has ships and guns and ammunition, but it cannot spring to twelve hundred charts overnight, or over a year's time

Some critic may observe "But why doesn't the Hydrographic Office pick out the important charts and copy them now out of its current funds?" To which the reply must be made that if any one of us all is a competent picker of the "important chart" he ought not to conceal his light under a binnacle but come right to Washington and pick.

The United States is dependent upon Great Britain for more than 75 per cent of the charts it may require for all the north and west coasts of Europe, for 46.5 per cent of the charts it needs of a very important part of the coast of Asia, and for various lesser percentages for charts in the rest of the world. For the whole world of charts, the United States must depend upon

(*Continued on page 277*)



In the map the oceans of the globe are divided into ten sections, and in each section is indicated the proportion of British Admiralty charts to the entire chart outfit required by the American navy In the tabular insert the same information is given somewhat more fully, the three columns indicating the number of issued charts from each of the three sources— U S Hydrographic Office, U. S Coast Survey, and British Admiralty

Where the charts come from on which our Navy depends

1. A pulpboard container in which the eggs are carried on their sides This has been proved wrong because the eggs are stressed at their weakest points, so its manufacture has been discontinued. 2. When the old honey-comb containers began to go, the projecting edges would bend down or break, leaving the outer row of eggs without protection The container Illustrated prevents this by a corrugated reinforcement for the outer strips 3. Another scheme for reinforcing the honey-comb container by locking it in an outer box 4 One of the most successful of the new containers, a succession of sheets of heavy pulpboard with molded cup containers This one carries the eggs on end and so avoids the objection made against the first one in this group

The old and the new in cardboard fiber egg carriers

When Humpty-Dumpty Travels

By Harry A. Mount

IN spite of the fact that cartons and containers for shipping eggs have always been a favorite subject with inventors, the same inefficient methods of packing and shipping which were used thirty years ago, when eggs were 15 cents a dozen, still obtain in 1921, with eggs at 50 cents or more per dozen

The explanation for this fact is that shippers, and in fact all commercial handlers of eggs, have become so used to the old-time honeycomb egg crates that they are reluctant to change. But recent scientific investigation and a campaign of education undertaken among handlers of eggs, has emphasized the fact that the proper packing of eggs is a matter of considerable economic importance

During the year 1920 the hens of the United States laid some 67,000,000 cases of eggs (each case containing thirty dozen), with an estimated value of $1,206,000,000 Most of these eggs moved a short, and many times a long distance, by rail to market. Most of them went by freight but many millions of dollars worth of the best "fresh laid" eggs were hurried to the cities by express The express companies alone last year paid $1,267,000 in claims for broken and damaged eggs, averaging $105,000 a month. And this, of course, represents only a part of the loss because where damage could be shown to be the fault of the shipper, as through improper packing, the claims were only partially paid or not at all The proportionate loss from *breakage in freight shipments was much less than by* express because the eggs were handled less, usually being loaded into a box car by the shipper, and being forwarded without rehandling to their destination But many hundreds of thousands of dollars were lost through breakage during freight shipment and all of this adds a staggering total to the bill which is ultimately met by the man who likes "ham and—" for breakfast.

This loss has always been considered unavoidable, when it was considered at all, until recently scientific tests undertaken by express officials in coöperation with scientists at Cornell and Columbia Universities, have shown that this loss can be very largely avoided Besides a number of tests to determine the best way to use the old style containers, twenty two new types have been tested Practically all of these new devices have been found superior to the old

In the tests the eggs are packed as for shipment and then carefully measured blows are delivered to the sides or ends of the crates and the contents then examined The most severe test given the containers is the tumbling test A drum originally designed by the Forest Products Laboratories for testing various packing cases used for munitions during the war, is used It is a hexagonal drum of metal with cleats so arranged on the inside that, when in revolution, it carries the crates of eggs upward and drops them in a series of falls ranging from one to seven feet It would seem at first thought that no fragile egg could emerge whole from such a test, and indeed of 300 eggs packed in a standard container in the most approved way, 160 were broken and most of the others damaged. The best of the new containers made a record of three eggs broken in the same test

Various methods of packing have been investigated in actual practise by making shipments from one investigator to another and then noting results It has been found that in 75 per cent of the cases where breakage occurs, proper packing would have prevented it, even with the honeycomb container One of the chief causes of difficulty, especially in small shipments of eggs, is the use of honeycomb fillers which have been used before Nearly always the projecting tips of cardboard which are a protection against side shocks have been bent down and if the case is at all roughly handled the eggs on the outside row are almost sure to be broken Another cause is the use of a "quarter filler"

(*Continued on page 277*)

The Why of Luminous Paints

By M. A. Henry

FOR centuries the firefly has been envied by men of science for the little creature did naturally that which science could neither reproduce nor explain He made a perfect light that is, a light in which all of the energy expended apparently was turned into luminosity

But just as man made mechanism has surpassed the eagle in the air, so men have given the firefly cause for envy in producing artificially a light which is well-nigh if not indeed, perfect and which unfailingly glows year in and year out If you would possess one of these "perfect lights" you have but to buy a two-dollar watch with an illuminated dial

Left After direct contact of 8 hours. *Center:* Through opaque paper after 8 hours *Right* Through steel after 24 hours

Action of radium-painted watch dial on photographic plate under various conditions

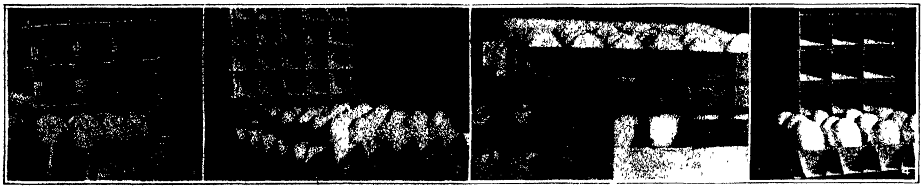
It is fairly well known that the mysterious element radium is in some way connected with the luminous material used for some years on the figures and hands of watches and clocks and which is finding a constantly broadening field of application, but the average man is puzzled to know how a material worth about $120,000 per thimbleful can be used to illuminate a two dollar watch dial

It is related that the existence of the substance which we know as radium was first discovered by the French scientist Becquerel while making experiments with phosphorescent substances He left a piece of pitch blende overnight on a holder containing a sensitized plate Later he developed the plate and found the outline of the pitch blende on it He repeated the experiment and finally *came to the conclusion that there was present some* powerful penetrating ray which could not be explained as a mere manifestation of phosphorescence It was not until the substance was isolated by Mme Curie in 1898 that the substance was named radium

Some thirty years have elapsed since Becquerel made his startling discovery and now, again, radium and phosphorescence are linked in modern radium luminous material

What really causes this new substance to glow in the dark? Is it the radium we see? If not, what is the purpose of using radium in it? The answer involves the whole theory of phosphorescence, for it ought to be

(*Continued on page 278*)



1. Holding the egg under tension by crossing two corrugated paper strips over and under it—one of many ideas of this sort. 2 A complicated carrier of heavy paper which puts the eggs under tension when the two halves are fitted together 3. Honey-comb container, with special "flats" separating the layers. These have star-shaped cuts to take the tips of the eggs and the design was, in the laboratory, the most successful of all. 4 Another tension device, which holds the eggs near their ends by fitting these into square cardboard receptacles

Four other designs which hold out promise of cutting the bill for breakage

Making the Most of Niagara

Projects Looking to the better Utilization of This Great Water Power

By Robert G. Skerrett

THE Niagara River will inevitably be utilized more extensively than now for the development of hydroelectric energy. The rush of those descending waters must be put to greater practical service wherever feasible without seriously impairing the scenic beauty of the Falls. Upon both of the governments concerned the *people are making insistent demands for bigger blocks* of power, and the authorities are listening sympathetically because of the logical promise of vast savings through the corresponding non-use of coal. No fewer than ten projects for water rights on the Niagara River have been filed with the United States Federal Power Commission, and among them are two that are sufficiently matured to warrant discussion.

Both of these contemplated hydroelectric propositions may well be considered as a single coordinated system, for they have been conceived and espoused by the same men, *i.e.* T. Kennard Thomson, C.E. of New York City and Peter A. Porter, of Niagara Falls. The *dual project, as illustrated on the opening page of this* issue, embraces first, the boring of tunnels through the massive foundation of Goat Island so that water may be led through them to large turbo-generators located near the river level on the down-stream end of the Island, *and*, next, the rearing of a dam squarely athwart the river at a point 4⅔ miles below the Falls, thus submerging the present Rapids. The Goat Island tunnels would lie wholly on American territory, but the dam would stretch from shore to shore in the Gorge and be international in character. However the citizens of this country would benefit by both of these engineering undertakings.

According to the existing treaty arrangement between the neighboring countries, it is not now permissible to divert for power purposes above Niagara Falls more than 56,000 cubic feet of water a second, and for *certain reasons the American allotment* of this is 20,000 cubic feet. It has been proposed that the combined total be raised to 80,000 cubic feet, and that each of the nations share equally. In other words Canada would have 4,000 cubic feet more than is the case today while our volume of water would be doubled. If the suggestion be adopted, the problem will resolve itself into governmental selection of such of the proposed installations as would be apt least to mar the great natural spectacle, while giving the largest yields in *energy and involving the fewest* engineering difficulties of a debatable sort. The Goat Island scheme meets these desiderata in many particulars and makes instant appeal to us, inasmuch as it would be located on our side of the river.

Goat Island would not have endured for ages in the erosive sweep of the Niagara but for the fact that it is an integral part of the massive ledge there underlying the river, and this has a very important bearing upon power development at that point. From the crest to the base of the Horseshoe Falls is a drop of about 165 feet, but the plan is to increase this head to substantially 200 feet *by lengthening Goat Island*. From east to west along its major axis the Island is today 2,800 feet long, but there is nothing to prevent extending it 600 feet by raising above the surface of the river the slightly submerged area at the upstream end.

By doing this it would be then practicable to drive the tunnels from water level to water level at a moderate angle and so insure a difference in drop of about 200 feet between the intake and the discharge ports of the conduits. At the same time the bores in their entirety could be cut through solid rock. Each aqueduct, when finished with a concrete lining, would have an internal diameter *of 20 feet*, and the descending waters led by it would be capable of developing 100,000 horsepower through the medium of suitable turbo generators. As now projected, only two tunnels would be excavated at the outset, furnishing 200,000 horsepower, but the *physical conditions* will ultimately permit a larger number.

As can be seen from one of the opening page illustrations in sinking the tunnels it would be a relatively easy matter to rear cofferdams to hold the river at bay *during construction* work, and the only subaqueous excavating of rock would be that required for clearing out the forebay. To screen the tunnel intakes from logs, ice, etc., there would be built an L-shaped reinforced concrete wall, rising from the ledge of the river bed to a sufficient height above the surface to divert floating objects into the currents sweeping onward and over the two Falls. According to the *engineering estimates, two tunnels can be cut and turbo* generators placed and made ready for service within an interval of two and a half years.

Today, in the vicinity of Niagara Falls it costs anywhere from $70 to $100 to generate by steam a horsepower year. If we strike an average, and call the outlay $80 per annum, it should be manifest that an economy of $120,000,000 in coal consumption may be effected while adding tremendously to the power available for industrial and other purposes. If it be assumed that a horsepower year in the run of steam plants calls for the burning of 8 tons of coal, then the substitution of hydroelectric energy will save each *twelve months quite 12,000,000 tons of fuel* which, otherwise, would have to be mined and transported from the nearest fields, those in Pennsylvania.

It is pertinent to emphasize here that in Buffalo, only about 25 miles distant from Niagara Falls, a big public service electric company develops two-thirds of its current at present by means of steam, and it is obliged to do this because it cannot obtain all of its energy from the comparatively near-by hydroelectric plants. Think of it, there within a stone's throw, so to speak, of the thunderous waters of the Falls this concern has to rely upon coal to generate 80,000 out of the 100,000 horsepower needed by its customers. *Thirty years ago the population of Buffalo was* 250,000 and is now 505,875, an increase of 108 per cent in three decades. The City of Niagara Falls, when incorporated in 1892, had a population of about 10,000, and in the interval it has grown 600 per cent owing principally to the influence of the availability of hundreds of thousands of horsepower in the form of electrical energy.

THAT the Niagara River is not yet furnishing sufficient electrical energy to meet existing requirements is evidenced by the Queenston-Chippawa development now being pushed to completion on the Canadian side of the international stream. As recently described in the SCIENTIFIC AMERICAN, *the plan is to generate at the start 210,000 horsepower and, later on, 472,500 horsepower. Recognizing the prospective greater demands for electricity in the course of the next few years, the projects discussed in the current issue are of timely interest. In the order of their preference, they are first, a dam a few miles below the Falls which will make use of the full flow of the river, and, second, an installation at Goat Island which, of necessity, would have to absorb waters that might diminish the impressiveness of the present Falls.*—THE EDITOR

Indeed, electricity is playing its part throughout a wide zone lying around Niagara Falls—the primary *source of power*. *Syracuse is drawing current from* that point, 160 miles away, and the loss in transmission is less than 10 per cent at a voltage of 60,000. Using a potential of 110,000 volts the Canadians are distributing current nearly 250 miles, and by raising this pressure to 220,000 volts, the radius of distribution could be lengthened to 500 miles. Under existing conditions the five pioneer companies located at the Falls are developing 650,000 horsepower, and it is a matter of common knowledge what this has brought about in the realm of electrochemical industries. Visualize, then, what momentous evolutions in our productive capacity would be made possible if a million and a half more of motive current *were at hand*!

Four years ago, in the State of New York alone, the power requirements totaled something more than 3,000,000 horsepower, and the demand was then increasing under normal circumstances at the rate of 300,000 horsepower each twelvemonth. Therefore, if the Goat Island project were pushed to completion, and equipped to provide a maximum of 1,500,000 horsepower, there would be a market for every kilowatt hour of its output within the span of a comparatively short while. It should be recognized, however, that this scheme would, of necessity, divert water from the Falls, and, according to the measure of this diversion, affect the volume *and possibly the scenic grandeur of the cataracts*. For this reason the proponents of this enterprise do not urge its adoption first, but advocate, instead, the construction of the dam farther down the river.

As an engineering undertaking, the dam proposed at Foster's Flats, a little less than 5 miles below the Falls, would be a much more ambitious enterprise, and would permit of the development of 2,000,000 horsepower of electrical energy. The plan is to take advantage of the drop of 102 feet in the river level between the foot of the Falls and the site chosen by rearing a massive structure, from shore to shore of the Gorge, 140 feet from the base line to the crest of the spillway. This barrier would raise the water level within the impounding area high enough to submerge the existing rapids and modify, at the same time, the character of the Whirlpool by making it larger and more impressive. But the scenic features of the Falls themselves, *would not be altered in any way*. As a compensation for the obliteration of the Rapids, the dam would create a new cataract having a drop of 100 feet and would call into being a series of rapids quite as spectacular as those that now stand in the sweep of the river just below the Falls.

At first blush, the mere suggestion of building a barrier athwart the Niagara River, with its minimum flow of 220,000 cubic feet of water per second, seems little short of preposterous, knowing that the ceaseless flood must be allowed to pass steadily on while the proposed structure is in course of erection. But nature is ready to lend help which would make the execution of such a *project far easier than one might imagine* offhand. The walls of the Gorge above Foster's Flats rise sheer several hundred feet from the tideway, but contiguous to the Flats the Gorge is considerably wider, *and on the Canadian side, especially*, the bank slopes at a comparatively easy gradient, terminating near the river in a fairly expansive low-lying area. At the same time, the river's path is considerably narrower at that stretch of its run. Owing to this state of affairs, the Flats present a strategic base of operations from which to start the rearing of a dam. That is to say, something like 50 per cent of the contemplated structure can be completed on dry land before any of the work trespasses upon the present course of the *Niagara at that point*. Let us be more specific.

As designed, the dam has a spread in cross section of about 650 feet at the base, and 30 feet or more of this lower portion will reach below the line of the riverbed and have its footing on the underlying solid rock. With a total height of 140 feet, the dam will be of an extremely massive character. The bottom section of the dam—at least that half of it that will rise from Foster's Flats—will be pierced by large temporary openings of culverts, and channels will be dug to them on the upstream side to serve as sluiceways for the entire volume of the Niagara when it becomes necessary to divert the river in order to bare the normal bed for building purposes along the line of the contemplated barrier. With this done it will then be a relatively easy engineering task to dam the usual or natural watercourse to facilitate *excavating the rock and erecting that portion of the* dam that will terminate on the American shore. When the dam is finished, then the sluiceways will be sealed and the waters impounded until they accumulate and carry the surface level back from the crest of the dam to the very foot of the Falls.

As most everyone knows, great quantities of ice are carried over the Falls and down the river during the winter and the breakup of that rigorous season, and the impact and the pressure of these floes must be withstood by any rigid obstruction rising in their path. Therefore, it is essential that these stresses be minimized and that the currents be free to carry the ice onward with a minimum of opposition while the bulk of the water is held in check. To this end, the dam will be fashioned with long slopes on the up- and the down stream sides. The heaviest of the ice should be able to mount the advance slope without difficulty under the impulse of the water beneath and behind it, and

(Continued on page 279)

A Problem of Electric Drive

The Advantages of the Diesel-Electric System Over the Straight Diesel Drive

BEFORE enumerating the advantages of the Diesel-electric drive over the simple or straight Diesel drive in which the engines and the propeller are connected to the same shaft, it would be well to describe briefly the make-up of the Diesel-electric drive unit.

The plant consists of one or more generating units, each comprising a Diesel engine of from 250 to 425 revolutions per minute, direct-connected to a direct current generator. The generators are connected in series and supply current to one or more slow-speed motors, running at one hundred revolutions per minute, which are mounted on the propeller shafts. At the present stage of their development Diesel-propelled ships will usually be of the single-screw type.

The speed of the propelling motor is controlled and its direction of rotation is varied by means of a rheostat, which controls the field current of all the generators, the latter being separately excited. By moving the handle of a simple reversing rheostat or by pressing certain buttons, the exciting current can be varied from zero to maximum in either direction. The voltage of the current delivered by the generators to the motor varies correspondingly, and so do the speed and direction of rotation of the motor. The engines run at constant speed and in one direction at all times, regardless of the operation of the motor.

As to the relative efficiency of the straight Diesel and the Diesel-electric systems, it would seem at first sight that the straight drive would be the more efficient of the two, since there is an inevitable loss of from nine to fifteen per cent (depending on the size) in the electrical equipment. However, as shown by Commander S. N. Robertson (*Marine Engineering*, December, 1920, page 974), the straight-Diesel must ordinarily be used on twin-screw vessels, while Diesel-electric will be used, for the present at least, mainly on single-screw vessels, and there is a considerable loss in the twin-screw ship as compared with the single-screw, "which brings out the rather remarkable fact that for low-power cargo vessels, the Diesel-electric installation is actually more economical than the straight Diesel."

On the point of relative reliability, it must be noted that with the straight Diesel there will ordinarily be two large engines running at about 115 revolutions per minute, each connected to a propeller. If one goes out of commission, the vessel is in trouble; if both go, it is helpless. On the other hand, with the Diesel-electric there will be anywhere from three to six or more small engines, and if one or two fail nothing happens except a reduction in the speed of the vessel. Furthermore, because of their small size the Diesel-electric engines can be more easily repaired at sea than the large, heavy, straight-Diesel engines. Another advantage is that a small Diesel engine is inherently simpler and more reliable than a large one, since its *cylinders are more easily kept cool and no piston cooling* is required.

In respect to the operation, the advantage is decidedly with the Diesel-electric, since the engine runs continuously in one direction when the ship is under way—it is not reversed nor is its speed changed. On the other hand, the heavy, straight-drive engines require a complicated reversing gear. A Diesel-electric operated boat can change from full speed ahead to full speed reverse in less than five seconds by a mere movement of a controller handle.

On the basis of weight and compactness it can be shown that, with the proper selection of the apparatus, a Diesel-electric equipment is lighter and more compact than a straight-electric equipment for the same ship, this for the reason that the high-speed engine is so much smaller than the slow speed straight-drive engine that a sufficient margin is left to include the electrical equipment and still have some margin in the matter of weight and compactness. However, it is conservative to rate both drives on an equal basis in these respects.

Although the first cost of a Diesel-electric drive is greater than that of a straight Diesel drive when the propelling machinery only is considered, advocates of the former claim that, when everything is taken into consideration, the earning capacity of a Diesel-electric driven ship will be found to be greater.

As to their limitations of capacity, straight drive engines of 6,000 indicated horsepower each, or 12,000 total horsepower per twin-screw ship, are being built today. The upper limit of capacity for the Diesel-electric system is about 6,000 horsepower per ship, since this is about as far as electrical manufacturers care to go with this apparatus under present conditions. This does not mean that this limit cannot be considerably raised in the future.

Steel from Japanese Iron Sand

A METHOD whereby iron may be smelted from the volcanic iron oxide sand of Japan, heretofore regarded as wholly refractory, has been discovered by scientific experimenters working for the War Department of that country. While the discovery cannot be employed as yet commercially, the cost of the iron so obtained being too high to compete with iron smelted from ore, the value, from a military standpoint, of the process to Japan, which, like every other volcanic country, is rich in deposits of iron oxides, is regarded as being great, inasmuch as it may place that country in an independent position so far as its supply of steel for military and naval uses, where cost is not the deciding factor, is concerned.

A statement made by the War Office on October 18, 1920, said, with regard to the process, which is being guarded as a military secret: "Iron sand is so general throughout the entire length and breadth of the empire that it has long been plain that if some method were discovered of smelting the iron from it, Japan would never suffer from want of steel. On the strength of the above, the necessary investigations were started as early as September, 1919, by a special committee, with experimental offices established in the Aomori Prefecture and with Dr. Kishi as chief engineer. The experiments of a year have now been crowned with tolerable success, and the process has been experimented with on a practical scale at the Penchihu works under the control of the Okura firm with very satisfactory results."

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Suggestion for Snow Disposal

To the Editor of the SCIENTIFIC AMERICAN:

A recent news item stating the enormous cost entailed in snow removal from city streets was of much interest to the writer. The abnormal increase in city street traffic in the last decade due to the constantly *increasing number of motor vehicles has made this a* paramount and gigantic problem facing all cities.

Weight and bulk are the prime factors in this problem, and, the slow, laborious and costly method of shovelling the snow into carts to be hauled away, different methods of melting the snow so that it will run into the sewers and others have all proved either impractical or totally inefficient in anything like desirable results. Melting the snow seems to be the best method yet tried out, but, when the atmospheric temperature is below 32 degrees, which it nearly always is in time of snow, unless the water quickly reaches the sewers it will freeze and do more damage than the snow did.

The writer, a high class mechanic and inventor, has given this problem considerable attention, and what seems to him a practical means of overcoming the handicap of not only weight and bulk but transportation as well, will be described.

By the use of a cylindrical rotary sweeper or a vacuum device on a motor truck, the snow would be swept up from the street and pressed into a cylindrical mold of say, about three feet in diameter and four feet in length with a core of about three inches through the center.

This drum-mold to be in either two or three segments so that it could be quickly released from around the snow after compression, this arrangement being easily accomplished by having it hinged or pivoted together with one point of contact releasable with any kind of latches and also a slightly tapered core so that when the snow cylinder was turned out this core could [illegible] quickly drifted out by tapping its small end.

The purpose of having this hole in the longitudinal center of this compressed cylinder of snow is for the insertion therein of a suitable length of say two-inch pipe to function as an axle, and by any number of means, a chain or rod hooked to each end of this pipe makes of the whole an easily moved roller, and any ordinary motor truck would be able to tow a train of from four to fifteen of these snow cylinders to a point of disposal.

A cylinder of this size would contain approximately twenty-eight cubic feet, and as snow is compressible to from four to ten times its original bulk, depending on pressure used, a space of one hundred square feet of a one-foot snow fall could be pressed into one of these snow "rollers" with pressure sufficient to reduce bulk four diameters.

It will be seen that these snow "rollers" may be easily dumped into a convenient stream or moved to and left on unused lots or rolled into any ravine.

On account of the peculiar "texture" of snow, any pressed mass of it has much greater tensile strength than an equal mass of ice, and it would be much less liable to be broken by rolling on the paved street than ice in the same form.

It would be necessary of course to open a passageway through the snow to point of final disposal, for the adhesiveness of both the roller of snow and loose snow on the ground would cause the roller to "grow" like a small boy's snow man.

In severe snow storms, the snow could be pressed into these roller shapes and moved to the gutter in nearby infrequently-used streets until final disposal could be made.

On residential streets the snow could be pressed into either square or rectangular blocks and piled up on the curbs just in the clear of the street where they would melt and run into the gutters.

Washington, D. C. C. J. MENASCO

Where Some of the Fish Go

To the Editor of the SCIENTIFIC AMERICAN:

I was glad to see your article in the SCIENTIFIC AMERICAN of Jan. 29th, on the question "Are we abusing our water resources?" Would have liked it much better if the question had been more general—something like this, "Are We Properly Conserving Our Fish Supply?"

The greatest destroyer of fish, next to themselves, is the water fowl. Strange to say, the most numerous and destructive kinds are protected by the law, and vast breeding grounds set aside for them, and a penalty imposed for killing them.

None of the fish-eating fowels is useful to man in any respect.

The increasing scarcity of all kinds of fish is due *more to the increase of these fowls than to increased* consumption by man. The quantity of fish caught in the Gulf of Mexico is decreasing every year and the price is getting higher.

When I first visited the Gulf coast fifty years ago, schools of sardines and red fish, covering hundreds of acres could be seen often. Now it is a very rare sight to find a school fifty feet square.

What has become of these vast schools of sardines? There are no canning factories on this coast to use them, and they have never been caught by the fishermen. The only answer is, they have furnished food for the vast and continually increasing flocks of sea fowl.

I have talked with many who have had long experience on the Atlantic and Gulf coasts, and one man, of unusual information along this line, said that he had estimated that the number of pelicans in the localities frequented by the fishermen of these waters exceeded one million, and that at a low estimate each consumed one hundred fish per day, a total of one hundred million fish per day by this one variety of sea fowl, and the pelican is exceeded in numbers by the gull more than three to one.

It is a reasonable estimate to say that all other varieties of fish-eating fowls consume twice as many as the pelican, which makes a grand total of three hundred million per day, or about three fish for every man, woman and child of our nation.

When I write to the Congressmen they reply that we have a fish commission whose duty it is to look after every phase of this question and that they have not recommended any legislation for protection against the water fowl.

Mr. Roosevelt boasted that he signed the bill setting aside certain islands in the Gulf of Mexico as breeding grounds for all kinds of fish-eating fowls. When such men as he can be influenced to commit such a crime what may we expect from our fish commission?

Meridian, Miss. J. M. T. HAMILTON

Left: Using sawdust as fuel in Georgia *Center:* A Colorado sawmill which, on the face of its showing, might fairly claim to be a sawdust factory *Right* Sawdust blower in operation at a big sawmill

Where sawdust is made and how it is used up

Jobs for Sawdust

Some of the Useful Ends to Which This Waste Material Is Being Put

By S. R. Winters

THOSE of us who are acquainted with the old-fashioned lumbering operations will have a vivid mental picture of an abandoned temporary mill-site carpeted with a foot or even more of the sawdust of yesteryear Thus substance was in good fact more or less of a nuisance, nothing could be done with it, nothing could be done to it save burning; and no profitable means of doing thus was at hand. To-day, however, lumbering is on a different scale, and the sawdust is available at a given point in such quantities that means for burning it not alone economically, but with actual utility, are easily at hand. Yet such is the rapid march of science that the sawmill man is by no means obliged to use his wood meal for fuel. Half a hundred other and better uses are open to him; and it is mainly of these that Mr. Winters tells us.—THE EDITOR.

THE towering sawdust heap, once considered the veriest of waste and but a shameful monument in betraying the movements of the sawmill in denuding our already depleted forests, is being salvaged to useful purposes The old fashioned pile of pulverized particles of wood is rapidly disappearing So self evident is this truth that the Forest Products Laboratory of Madison, Wis, challenges anyone to discover a vast accumulation of the seemingly worthless material where the arteries of railway facilities course, or in proximity to cities A striking epitome, almost unbelievable, attests to the fact that 51 profitable uses have been developed for the utilization of sawdust

From manufacturing soap and fertilizers to the purification of gas and in lettering floral emblems, the range of its recovery is well-nigh limitless Green sawdust, barring its consumption as fuel, is narrowly restricted in utilization Once dried, however, the pulverized particles are adapted to a half-hundred uses Commercial concerns in large cities have made its recovery a business, invading wood-working establishments, planing mills, sash and door factories, and furniture establishments for the hitherto accumulated heaps of refuse The material is transported to the plant of the sawdust company in wagons and delivered to the ultimate consumer in bags or bulk consignments Sawdust is graded with respect to species and fineness, the latter requirements being insured by sifting screens capable of yielding varying degrees of fineness according to a diverse market Resaw sawdust may be one classification while particles from sanding machines constitute another grade The latter is described as wood flour, although radically differing from the product employed by manufacturers of explosives and makers of linoleum

The utilization of sawdust in the manufacture of fuel briquets is in its infancy One commercial plant in Los Angeles, Cal, is in operation, and a similar establishment has been erected in Vancouver The briquets are fashioned in cylindrical shape, are three and one half inches in diameter, and of varying lengths, with 12 inches prescribed as a happy medium Special machines are purchasable, and Europe is producing fire lighters from sawdust The latter is sandwiched with rosin or pitch and transformed into compact cakes, which are scored to permit small pieces to be broken off with ease Milady's fur is not impervious to the refining influence of the pulverized material as the saw rips its way through huge monarchs of the forest Furs are renovated by being tumbled in drums where sawdust acts as an absorbent in extracting grease and dirt

Hams, bacon, fish, and sausage may be pickled or cured under the smouldering fires of hardwood blocks and sawdust A desirable flavor is thus imparted and the preservative qualities of these products strengthened The meat absorbs the smoke from four to five days while the temperature hovers around 75 degrees Fahrenheit The method can be hastened by increasing the temperature While green hickory sawdust is a popular favorite, particles from the maple, oak, walnut and even mahogany, have their adherents Widespread use is made of sawmill refuse as an absorbent on floors, meat and fish markets, hotels, abattoirs, machine shops, garages, factories and warehouses being consumers in this particular The abandoned or reconverted barroom once was a claimant of the material as an absorbent on floors Of minor consequence, although used in some instances, is its adaptation as an extinguisher of oil fires. Dry sawdust is employed effectively for cleaning and drying metals The latter when cleaned in a pickling bath, or when subjected to a plating solution, or greasy pieces produced on automatic machinery in which they are deluged with a stream of oil, may be dried in sawdust and polished to a most pleasing effect when subjected to agitation and more or less intense friction in a tumbling barrel.

As a bedding in stables the subject of this article has a limited use, although shavings have excessive claims. The former is considered a better absorbent Twenty concerns in the United States make and lay composition flooring, which is constituted of a base of magnesium oxychloride, formed by the reaction between magnesium oxide and magnesium chloride Substances serving as fillers are of a varying character, but sawdust is one Its percentage in composition floorings varies from 4 to as high as 50. Ethyl alcohol has long been a product of sawmill waste, the material being inserted into rotary digesters, and treated with dilute acid at a high temperature, thus converting the cellulose into fermentable sugars. These are then separated and fermented into alcohol There are promising developments under way looking to the destructive distillation of hardwood sawdust though commercial operations have no tangible support. Hardening and annealing of metals is another very limited method of utilizing waste from the buzzing saw the product acts as an insulator in avoiding too rapid cooling of steel

In the consignment of canned goods, as well as fragile articles, sawdust is a protector It affords insulating influences in cold climates and thereby prevents the freezing of liquids in transit. Likewise, the material is suitable for insulation purposes in the construction of ice houses, refrigerator cars, and storage houses Sound-deadening is a term associated with the offerings of the sawmill but other materials have displaced its use in this particular Meat is shipped in Europe by this prescription "Entire unboweled cattle or large suitable severed pieces are sprinkled with acetic acid and then packed and transported in sawdust impregnated with cooking salt and sterilized" Grapes from California course their zig zag routes across the continent when enveloped in sifted redwood sawdust Soaps, recommended for use by mechanics, are on the market, sawdust being their major ingredient Waste from the lumberman's equipment is frequently used in a partly charred state either alone or mixed with wood ashes as a fertilizer

In at least one instance, sawdust has displaced sand in the making of a cement barn floor The testimony subscribes to its merits which consist of warmth and a minimum of wearing on the hoofs of cattle It likewise shares the distinction with finely chopped straw as a filler in burning clay products. It meets the requirements of the manufacturer of porous clay bricks and tile for some substance for consumption during the burning and thereby leave the finished product filled with fine cavities or pores Purification boxes filled with a mixture of iron oxide and shavings are used in coal gas plants and producer gas plants for removing the sulfur from the gas Experiments are being made in producing paving blocks and some asphaltic binder from this pulverised wood, although results are not yet available. One plant in the United States is producing oxalic acid from sawdust, and the product has commercial possibilities in the manufacture of carborundum and calcium carbide Charred sawdust in the electric furnace is the method of approach The drying of fresh concrete can be delayed by spreading a layer of the waste from the lumber mills to a depth of three or four inches.

Plants have been erected in the Pacific Northwest with the view of producing a gas of high calorific value from the distillation of wood under high temperatures. Such plants bear similarity to ordinary coal gas equipment, the wood being distilled in gas retorts The resulting charcoal can be consumed directly under the ovens, or can be burned in a water gas plant, the gas from which can be diverted into the mains. Oatmeal wallpaper utilizes sawdust for its distinctive surface, while it is employed in decorative lettering in a fashion similar to the manufacture of raised wall paper.

Making the Box Car a Dump Car as Well

IN order to increase the uses to which the usual box car may be put, there has recently appeared a new type of box car in which special hopper bottoms are provided. The details of these hopper bottoms are brought out in the two accompanying views, which show, first, the outside hopper and chute arrangement, and secondly, the hopper trap doors and frame inside the car

It is hoped that this new construction will materially facilitate the handling of grain and other loose materials in box cars. By removing a pin the bottom of the car opens up and the contents come through the chute on either side of the tracks. There is no opening mechanism, the doors being closed and opened by a simple locking-bar arrangement If the contents cannot be dumped through the hopper, then the car is used in the same manner as the ordinary box cars, being provided with the same kind of side doors.

Outside and inside views of the hopper mechanism of the new box cars provided with dumping facilities

Tank Scows for Live Fish

FOUR blunt nosed scows arrived in New York harbor the other day, after a twenty-four day voyage down the coast from Quebec, Canada They moored at the docks of the Fulton fish market, and there unloaded their cargo of 200,000 pounds of live eels

Now these scows are no ordinary plodders, but are the first live-fish carriers in the Western Hemisphere Their appearance marks the beginning of an attempt to supply the American housewife with live fish instead of fish which has been dead for a week or more The designer of these fish carriers is Gottfried Friedrichs, who in addition, is director and part owner of the enterprise. They are patterned after Scandinavian and German models, declares Captain Friedrichs

"They are simply long narrow rafts," he explained "Water-tight compartments at both ends enable them to float. Between these compartments at the extremities, there are seventeen smaller ones through which the sea is passing all the time. In these the fish are kept, and swim about. The holes in the sides which admit the sea are not large enough to permit the fish to escape."

That, in brief, is the principle on which the vessels were built. Three of them are 110 feet long, and the fourth is about half this length, or 48 feet The smallest of the fleet has two gasoline engines which enable it to travel under its own power, whereas the others have only a rude steering gear and are compelled to depend on a tug.

In quiet water, however, and with a fair wind, the larger scows can dispense with towage, for each scow carries a twenty-five-foot mast, from which a simple lateen sail may be flown. The sail is useful in navigating rivers and as an aid to steering when at sea Captain Friedrichs asserts that next year he will equip the three large scows with engines, thereby bestowing on each craft the power of self-propulsion.

The water-tight compartments, both forward and aft, are utilized as sleeping quarters for the crew. These are marked by deck houses rising above the deck level to a height of six feet. Each house contains accommodations for two men and an oil stove on which food may be prepared. The men "grub" for themselves.

From the end of the ship to the point where the fish-containing compartments begin, the distance is ten feet. On each scow there is, therefore, twenty feet of water-tight, air-filled space for the purpose of giving buoyancy This is more than sufficient for the purpose; in fact, the wood used in the construction was so new and untried that it was necessary to add no less than five tons of ballast to each scow

The wood used in the scows is British Columbia fir All of each vessel, not even excepting the bottom of the tanks, is constructed of this wood A metal construction would prove injurious to the fish, according to Mr. Friedrichs The tanks taper from the deck width or beam of twelve feet to the width at the base of ten feet Their depth is three feet which is the draught of the scows. The opening of the tanks on deck is two and a half feet, and the opening is covered and barred in a manner similar to hatches aboard other vessels

The hatch covers are thrown off at sea and the fish examined by means of long hand nets. The fish that have died or fallen sick are sorted out and cast overboard This is hard work at any time, and it was especially hard on the recent voyage, due to the fact that there was only a skeleton crew aboard There is provision for a crew of fifteen including the captain, aboard the scows

The eels which were brought to New York on the recent voyage were caught by means of 150-foot traps stretched across the St Lawrence River The eels swimming down stream swim into the traps which are made up of closely-meshed chicken wire This wire cuts off their retreat and the fish wind their way into a box like arrangement from which they can be scooped by the trapper.

A small vessel with a sharp prow, built with tanks for containing live fish, collects eels at the various traps and then discharge their collections into the scows which wait day after day until their tanks are full

Two tank scows which recently carried a large supply of fresh fish from Quebec to New York City

Heating Water with Exhaust or Live Steam

THERE has recently been placed on the market the ingenious storage heater shown in the accompanying drawing which is intended to furnish hot water in hotels, apartment houses, factories, etc Exhaust or live steam is supplied to the heating element, where it condenses and heats the water in the tank

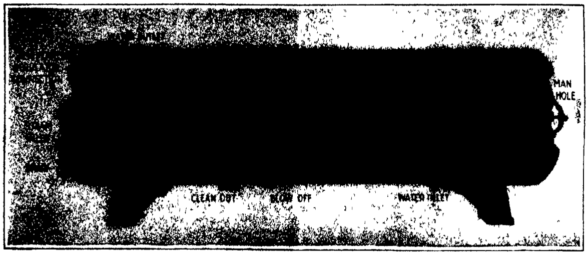
The storage type heaters insure a reservoir of hot water at all times In their general form they have been on the market for years, but the present storage heater departs from the general practice as regards the construction of the heating surface It has been standard practice to use U tubes for the heating element of a storage heater Careful study and experimentation have established the fact that practically all of the work of heating is done in the upper or outgoing portion of the U-tube, and that the lower row or return portion of the U tube simply acts as a drain pipe and returns the condensed steam to the steam head It is, therefore, obvious that in a U tube heater practically half of the tubing is useless as a heating medium

Furthermore, a certain volume of steam, when condensed, will occupy only about 1/1600 *of the volume of the steam* Therefore, the large area of drain tubes in the U-tube type of heater is absolutely unnecessary and waste material

The present storage heater is designed with a certain number of straight tubes in the steam element, and these tubes are of sufficient length to insure that the required heating will be taken care of and all of the steam will be condensed when it reaches the rear end of these heating tubes It is therefore necessary to provide only a sufficient area of drain tube section to carry the condensation back to the steam head

The heating surface consists of seamless drawn brass tubes expanded into a fixed tube plate at one end, and a floating tube plate at the other end, permitting expansion and contraction of tubes without strain of the tube joints This straight tube construction, as contrasted with U tube, eliminates the necessity for removal and scrapping of a large portion of the tube surface to replace an inner tube, as is the case in U-tube construction These straight tubes are all of the same length, and this reduces the spares necessary to be carried in stock, and in fact permits the purchase of stock tubing to replace worn out tubes

The various features of the new storage heater are clearly brought out and labeled in the accompanying drawing



Broken away view of the newly-introduced storage heater for supplying hot water in hotels, apartment houses, etc.

The Musical Hospital

How Flattened and Fractured Brass, Wood and Stringed Instruments Are Repaired

By Albert A. Hopkins

WHEN you go to the opera or a concert you see the conductor with his back to you and his face to the orchestra. On the left at front are the first violins, behind them are the violoncellos and the double basses. In the center are flutes, piccolos, oboes, English horns, clarinets, horns, bassoons, trumpets and drums; on the conductor's right are the second violins, violas, tubas and trombones while in the center at the back are the instruments of percussion. Such is, in brief, the orchestral scheme. Few people, however, when they view a perfectly balanced orchestra, realize that many of the instruments are subject to accidents which for a time, incapacitate them from giving forth their accustomed sounds. It is our privilege to show some illustrations of what might be termed "a musical hospital" which has advantages over the ordinary hospital in that there are no ambulances and the patients never die. So the atmosphere is always cheerful and "atmosphere" is used advisedly for there is no other place on earth with so much local color as a musician's repair shop. Of course there are foreign musicians with the flowing ties and the uncut if not unkempt hair which go to make up the artistic personality. But for most of the artists their instruments are their breadwinners and few musicians achieve such a meed of success that they have many replicas of treasured instruments.

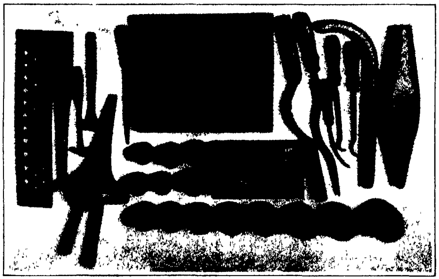
The things which can happen to a musical instrument are legion. There may be a train wreck, a trolley car may go wrong or an automobile run over the musical treasure, but all is grist to the repair shop. It should be stated, however, that instruments are grouped into classes and a man who repairs brass does not try his hand at the wooden wind instruments, such as flutes, oboes, clarinets, saxophones and bassoons, while the stringed instruments have special and highly skilled surgeons all their own.

The brass instrument shop is the most picturesque of all, which may be gathered from our cover engraving which we are permitted to show through the courtesy of Mr. H. Gerson of Carl Fischer's in New York. Here instruments such as horns, trumpets, trombones, tubas, etc., undergo revivifying processes so that the former owner would hardly know the rebuilt and *refurbished instrument, for the great public likes an* instrument not only without dents but highly polished or plated as well. Horns come in bent out of all shape and almost literally as flat as the proverbial pancake. Our first thought would be to consign the once tuneful carcass to the cellar of the junk man as old brass, but not so does the musical instrument repairer consider it. Men in this trade are of unusual intelligence and withal have a great love for their work. The most interesting operation is the taking out of dents and the reforming of flattened horns without unbrazing the bells. This is accomplished by a series of cylinders or rather portions of cylinders, balls, washers and odd-shaped pieces of metal of gradúated size which are introduced into the bell, tube or slide. All sizes are provided so that no tube is too small, special hammers do the rest after the balls are wedged in and dents are thus perfectly obliterated. One of our engravings shows a rather full outfit of tools for this purpose. Of course valves become worn, leaky and otherwise out of order and here other specialists are called in, a man who works on piston valves rarely repairs circular valves and vice versa. The wood-wind shop adjoins and is not as picturesque as is the brass shop, neither is the string shop, but the results obtained in the latter are most extraordinary of all. A violin, a viola, a violoncello or a double-bass is sometimes put out of commission by an accident such as an automobile running over it. Almost any virtuoso will tell you that his instrument was improved in tone after a bad smash-up and subsequent repair. We do not believe that is true, as a rule, but there are cases which certainly go to prove it.

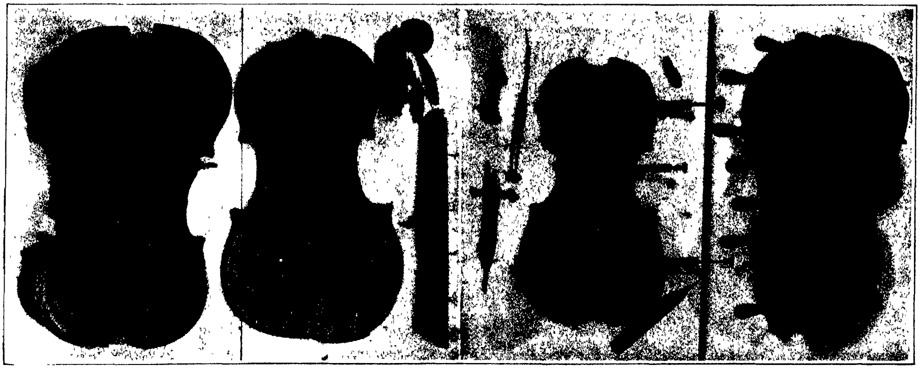
There are certain technical terms, as the back, belly and sides, to be considered, for the violin contains in its interior a mass of air which is let out by the *f-f* holes. There is also the neck, scroll, the bridge, the pegs and the strings, and, last but not least, the varnish which plays such an important part in the tone. If a bridge, tailpiece or the neck and scroll are destroyed it is an easy matter to replace them, but not so the back, belly and sides, which are made of seasoned wood sometimes hundreds of years old. The tools of the violin maker are peculiar and consist of those which would be found in any cabinetmaker's shop, plus iron clamps, scrapers, oval planes (often of minute size as planes go), callipers, purfling gages, chisels and many other special tools.

(*Continued on page 280*)

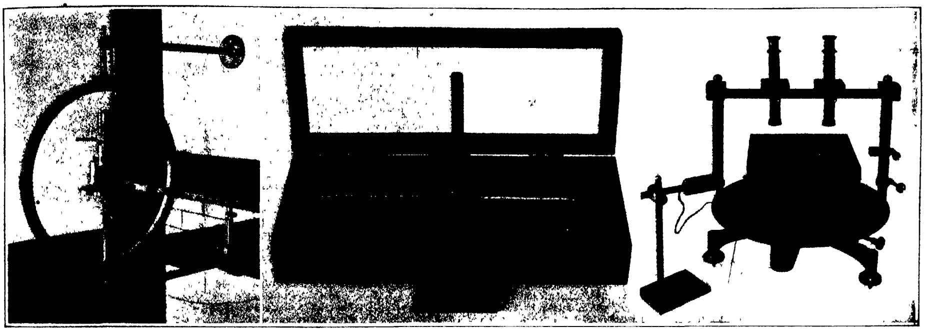
Repairing brass musical instruments. Taking out dents and polishing band horns



Tools for taking out dents in brass musical instruments. The balls are in *successive sizes and are introduced into the bells and tubes* and the dents hammered out



***Left*: Repairing the damage by gluing up the cracks. A valuable Genoese violin of 1779. *Right*: Clamping the belly of a violin to close up cracks and clamping the glued sides to the back and belly**



Left: New magnetometer designed by the Bureau of Standards for making a direct measurement of the magnetic moment of the needle system. *Center:* A standard compass. *Right:* Compass testing stand developed for determining the calibration error of compasses. Two telescopes are employed for sighting on the compass under test

Some of the equipment used by the Bureau of Standards in testing magnetic compasses

Testing Magnetic Compasses

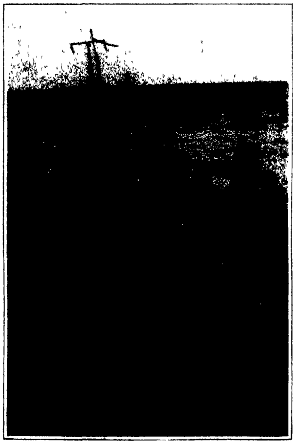
ALTHOUGH the subject of testing magnetic compasses was first broached by the National Bureau of Standards under the exigencies of war, complying with requests from the War Department and the United States Shipping Board, the investigations reveal information no less applicable in peace than in the days of human wreckage. The studies involving the construction of special testing apparatus, observations as to the behavior of varying types of instruments, and the performances of individual compasses, are accentuated by reason of the dearth of scientific data relating to magnetic compasses previous to these experiments.

Of outstanding interest perhaps, in connection with the testing of compasses is the designing and installation by the Bureau of Standards of special equipment: a magnetometer for making a direct measurement of the magnetic moment of the needle system. R. L. Sanford, a physicist of the Bureau of Standards, technically describes the apparatus as a suspended system which carries besides the needle a concave mirror and an aluminum vane which swings in an enclosed chamber and serves to dampen the oscillations and bring the system quickly to rest. A permanent magnet, adjustable in position by means of which orientation and sensitivity of the suspended needle can be controlled, is mounted on the instrument. When the control magnet is so stationed that the needle assumes an east west position it is possible to determine the magnetic moment to a degree of accuracy approximating five per cent without arresting the compass card. The latter is difficult of attainment in liquid filled compasses. The magnetometer is mounted, with the suspended needle at the center of a large coil of known constants, thus facilitating calibration. A support is a fixture of the instrument for holding permanent bar magnets used for compensating or adjusting compasses.

The presence of magnetic disturbances somewhat hampered the tests at the Bureau of Standards, a factor responsible for accuracy not in excess of five per cent. Pivot friction, calibration, period, and damping are the characteristics around which the testing of magnetic compasses revolves. Excessive pivot friction may result either from injury or imperfect materials, or from shabby workmanship. Sensitiveness to slight changes of direction is the object sought by the pivot friction test. The method of test consists of deflecting the compass by a small specified angle, and determining the difference in reading before and after the deflection. The test is repeated, the compass bowl being oriented in varying directions.

A simple testing stand, as illustrated by one of the photographs, was constructed for determining the calibration error of compasses. The table can be rotated about a vertical axis, graduated around its circumference so that any angle which it may be turned can be read by means of an adjustable index. The use of a vernier insures the reading of angles to 0.1°. Two telescopes, stationed on uprights, are employed for sighting on the compass under test. A small coil is used for deflecting the compass while testing pivot friction, period, and damping. Compasses having vertical cards when tested, necessitate a modification of the sighting arrangement. When testing for calibration, the compass is placed on this stand and the telescopes focused on the north and south points of the card. Forthwith the compass being tested is removed to a distance and the standard compass is given a berth on the stand. It is raised or lowered by negotiation of an adjustable stand till the index line is in focus. The telescopes are free from molestation after the initial adjustment. The table is oriented so that the image of the index line on the standard compass is in unison with the cross hairs of the telescopes. The adjustable index is set to zero and clamped. Once the table index has been adjusted by means of the standard compass the instrument to be tested is replaced on the stand and the error on the north heading determined by noting the difference between the compass reading and the index reading. The calibration error is the difference between the reading of the compass and the correct reading on any heading.

The so-called "period" or time of oscillation of a compass depends upon the moment of inertia of the card, the magnetic moments of the needles, and the horizontal intensity of the magnetic field. The test is made by a stop watch and auxiliary magnet or coil to start the compass swinging. The card is set swinging and the time observed for the half period or the complete period as specifications may indicate. The period is taken as twice the time which elapses between successive transits of the card in opposite directions through its position of equilibrium when released from an initial deflection of 15°. The method of determining the damping of a marine compass is to find the ratio of two successive swings on the same side of the equilibrium.



U. S. Submarine "L-1" partly submerged and being towed to a repair station

A New American Clay for Loading Paper

A HIGHLY colloidal clay which exists in large deposits in the intermountain regions of the United States has been found by the United States Forest Products Laboratory to be valuable as a loading material for giving finish and printing qualities to book paper. When this clay is used in conjunction with English china clay the retention of the English clay is materially increased and the paper produced has a superior finish and appearance, and a more velvety feel. The admixture of this clay similarly improves the retention of other fillers and is especially desirable with some which have a low retention.

The ability of the new clay to remain in suspension may make feasible the installation in paper mills of a central mixing plant, from which the loading material can be piped a considerable distance to the beaters without danger of setting or clogging of the pipe lines, and with the assurance that the concentration will remain uniform. The properties and use of the new loading material are more fully described in a report which may be obtained from the laboratory on request.

A Submarine in Trouble

SUBMARINES, like all other ships of the sea have their troubles; indeed, some people are inclined to think that they have more than their share. But we must remember that, in the very nature of things, the handling of a submarine is a far more difficult matter than the control and navigation of ships at the surface. Beautiful invention though the periscope is, the view which is obtained is not so complete as that of the captain on the bridge, and a search of the records will probably show that most injuries to submarines by collision have occurred when these little craft were submerged.

The accompanying photograph shows what happened to "L-1" when she was cruising off the Delaware capes where she was rammed by the steam pilot boat "Philadelphia" and her hull was breached. Now the perforation of her hull is a very serious matter for a submarine, if only for the reason that her reserve buoyancy is comparatively limited and any considerable inrush of water is sure to prove more than her pumps or other water expelling means can take care of. In this particular case the boat was saved by her commander running her on the beach in the inner harbor of the Delaware breakwater. The view which we present is taken looking aft, and the submergence of the after portion of the boat is due to the fact that her engine room is flooded with several feet of water. Fortunately, none of the crew was injured, and at the time that our photograph was taken members of the crew are on deck and the rescue boats are towing the submarine to a repair station.

The Heavens in April, 1921

The Tidal Friction and the Toll It Takes

By Professor Henry Norris Russell, Ph.D.

THERE is always something satisfactory about the "cleaning up" of a scientific problem--the leaving of it in such a well ordered state that we may feel that, for the present, nothing more need be said, and such an outcome is the more pleasing when the problem has long been outstanding and has almost been given up as insoluble

A very beautiful example of such success is afforded by the old question of the influence of tidal friction upon the rotation of the earth and the motion of the moon Known in its main outlines for more than a century, this problem has remained perplexing until within the past few years, when it has been "cleaned up' in admirable style by the activity of three English astronomers—Dr Fotheringham of Oxford, Dr Taylor of Cambridge, and Dr Jeffreys of Manchester

The matter has been mentioned in these columns more than once in past years, but it may be worth while to go over it briefly again From the days of Halley it has been known that the moon is moving around the heavens at a slightly more rapid rate now than in the days of Greece and Rome There are a good many ancient records of eclipses of the sun and moon, and upon comparing these observations with the positions calculated by reckoning backward with the present rates of motion (which are very accurately determined), we find discordances which can be explained only by a slow, steady change in the rate of the moon's motion

More than a century ago Laplace provided the first explanation of this singular fact, showing that the slow change in the shape of the earth's orbit, due to the attractions of the planets, would cause changes in the sun's attraction on the moon, and produce a gradual, though very slow, acceleration of its motion At first it seemed as though this would completely account for the facts, but later calculations (which demand extreme labor and skill) showed clearly that only a part of the observed change could be explained in this way There remained an apparent increase in the moon's rate of motion, which could reasonably be explained only as arising actually from a gradual slowing of the earth's rotation The days being longer, the moon seems to go farther in a day.

Now there is a real and obvious cause at work which might produce such an effect—the friction of the tides as they rise and fall in the oceans and on the coasts of the world This friction is steadily converting energy into the form of heat, and it is therefore certain that it must gradually slow down the motion from which it abstracts the energy—the rotation of the earth The theory of this tidal friction was thoroughly worked out by Sir George Darwin, who showed that as the earth came to rotate more and more slowly, the moon must inevitably be driven, by the same tidal forces, into an ever larger and larger orbit, and that the length of the month must in this way increase

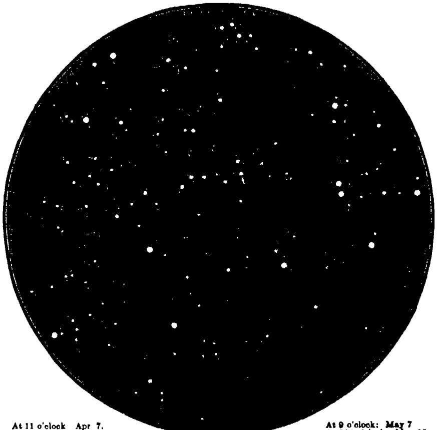
Under existing conditions, a simple calculation shows that the length of the day must be increasing at a greater proportional rate than that of the month, so that the number of days in a month diminishes, though, measured by an unvarying standard, both are longer than before.

Days and Months

Two outstanding questions, however, remained very difficult to answer First, at what rate the day is growing longer; and second, whether the actual friction of the tides is competent to produce an observable effect The only way to answer the first question is by a study of the ancient records of eclipses and other observations of the moon. Dr Cowell, of Greenwich, from such a study, concluded a dozen or more years ago that the sun, too, appears to be slowly accelerating its daily motion--as it ought to do if the days are growing longer while the years are not. But a complete discussion of the available records of antiquity was left to Dr Fotheringham It was a very difficult work, demanding a thorough knowledge of classical literature and archaeology, in order to interpret correctly the fragmentary and confused records which are all that remain to us; and at the same time a mastery of the intricate calculations which are always required in following the motions of the moon. But in a series of masterly papers the whole of the existing material was handled, with the very satisfactory result that all the various sorts of records—eclipses of the sun and of the moon, observations of the position of the moon with respect to the stars, and so on—could be satisfied, within reasonable limits of error, on the assumption that the sun moved 2" farther eastward in the heavens every century than in the century preceding, while the similar excess of motion in the case of the moon was 21". About 18" of the latter is known to be due to the changes in the earth's orbit, leaving 8" for the tidal influence.

The accordance of the results derived independently from the various sorts of ancient observations is sufficiently good to make it practically certain that the earth is rotating more slowly than it did two thousand years ago, and that, at the end of each century, a day is longer by a little less than 1/800 of a second of time than it was at the beginning of the century. This will explain directly the apparent acceleration of the sun, and, when allowance is made for the change in the real length of the moon, will account for the behavior of the moon, too

Hence, from the observational side, the problem appears to be well cleared up. But the theoretical implications of this minute change in the length of the day are startling. The earth is so massive, and its rotation so rapid—a point on the equator moving at more than a thousand miles per hour—that even a very small change demands an enormous alteration in its energy. A straightforward calculation, though one involving the use of very large numbers, shows that to lengthen the day by 1/800 of a second in a century demands the abstraction of energy from the earth's rotation at a rate corresponding to the action of about two and one-half billion horsepower continuously during the whole time! Until within the past few years, it seemed very doubtful that the friction of the tides could be great enough to account for so huge an amount.



At 11 o'clock Apr 7.
At 10½ o clock Apr 14
At 10 o clock Apr 22
At 9½ o'clock · April 30.
At 9 o'clock: May 7
At 8½ o'clock May 15
At 8 o'clock May 23

The hours given are in Eastern Standard Time When local summer time is in effect, they must be made one hour later 12 o clock on April 7, etc

NIGHT SKY: APRIL AND MAY

Horsepower by the Billions

In the deep sea, where the water rises and falls but a few feet, and the currents are slow, there is very litttle friction; but near the coast, where powerful currents run in shallow water, the situation is different. There are few parts of the sea where the depths, tides and currents are well enough known to permit of even a roughly accurate calculation. But Dr. Taylor, taking the comparatively complete data for the Irish Sea, showed that in that small area alone the tidal currents dissipated energy enough to account for about two per cent of the whole amount demanded by theory. Dr. Jeffreys, following his lead, has collected such information as was available about the tides and currents in shallow seas, all over the world; and has calculated the rate of dissipation of energy into heat by the friction. His results are altogether remarkable.

High tides, of course, go with strong friction; but even more important are strong currents over large areas of fairly shallow water (fifty fathoms or less) The enormous tides of the Bay of Fundy, for example, use up on the average about 60 million horsepower The tides in the channels between the Arctic islands west of Greenland, which rise fairly high and are accompanied by very strong currents, appear to do about four times as much work; so that some 300,000,000 horsepower is accounted for on the American side of the North Atlantic. On the European side the total effect of tidal friction appears to be about as great, being localized mainly in the narrow seas which surround and separate the British Isles

The South Atlantic and Indian Oceans contribute relatively little, since there are few shallow bays or gulfs along their shores Along the east coast of Asia, however, there are great areas of shallow water, and these, from Malacca Strait to the Sea of Okhotsk, contribute altogether some 450 million horsepower

By far the most remarkable region in the world, however, is Bering Sea, where tidal currents of unusual strength sweep in and out over very large areas of shallow water The existing information is scanty, but enough to show pretty plainly that there is more tidal friction in these waters than in all the Seven Seas besides Dr. Jeffreys' estimate of the work of friction here is two billion horsepower, making a total for the world at large of three billion horsepower, in round numbers. This is substantially equal to the amount required to explain the observed changes in the apparent motions of the sun and the moon. The agreement of the two figures is all that could be hoped for in view of the incompleteness of the tidal data

One or two incidental researches are of interest. The real length of the sidereal month is increasing each century by about 1/46 of a second of time. But since we compute it with the actual day, and not with a day measured by an absolutely uniform time-piece, and since, at the end of a century, 27⅓ days have grown longer by 1/80 of a second, the month appears to us to be shortening by about 1/85 of a second per century. To the increase in the real length of the month corresponds an increase in the moon's average distance from the earth—at the rate of 7⅓ feet per century! Minute as this appears, the rate at which work is done in pulling the moon away against the earth's attraction is equivalent to nearly 100,000,000 horsepower acting continuously.

The Heavens

Turning from these recondite matters to the familiar face of the starry skies, our map shows us that, at our chosen hour of gazing, we shall find the Great Bear almost overhead, but a little north of the zenith. The line of the pointers leads us down to the Pole Star, and past it to Cassiopeia and Cepheus, low in the north.

(*Continued on page 280*)

Optical Tricks with Electric Sparks

By W. A. Kimball

THE number of alternations, per unit of time, of an electric spark jumping between the terminals of a spark gap can be determined by proper apparatus in cases where the alternations are too rapid to be detected by the eye, if the apparatus can be made to send to the eye reflections that have frequencies slow enough to be received by the eye Applying this principle the writer constructed apparatus as follows

From heavy cardboard, one side of which must be black, cut a circular disk 45 centimeters in diameter From white paper cut circular disks 4 5 centimeters in diameter. Arrange a row of 17 white disks equi distant apart on outer section of large black disk Arrange a second row of white disks inside first, eleven in number The third row of white disks, five in number, will occupy remaining section of large black disk Care should be taken to place the three rows of white disks equidistant from each other as well as to have the white disks of each row equally spaced

One could substitute for the above a circular cut wooden disk, painted black and when dry painting smaller white circular disks on the black background

If the class room or demonstration room is first carefully darkened and the large disk is placed on a rotating machine and rotated at varying speeds in front of an electric spark of sufficient size to illuminate the entire disk, many interesting results can be obtained

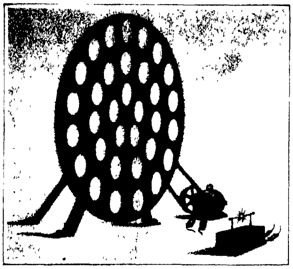
By regulating the alternations of the spark and speed of rotation of the disk you will observe that a certain speed of disk will cause one of the rows of white spots to appear to remain stationary while the other rows are moving. Again, if the operator should increase the speed of the disk he can make the row which previously seemed stationary move forward in the same direction as the rotation of the disk. By decreasing the speed of rotation this row of white spots will move in the opposite direction While one row at a certain speed appears to move in one direction another row will appear to move in the opposite direction and the third row may appear stationary.

The effects that can be produced are interesting and varied and the principles involved are useful in explaining to a group of students the reasons for different effects produced by moving pictures It is easy to explain clearly why carriage wheels in motion pictures appear to be rotating backward at certain times and forward at other times during the same picture

The size of the large disk and number of spots in each row is of course optional. The larger the disk and the greater number of white spots and rows, the more varied the results and the more interesting

Reclamation Project in Northeastern Brazil

THE *Diario Official* of October 30 contained decrees approving the contracts by the Inspectoria de Obras Contra as Seccas with two English and one American firms for the administration of the construction of dams, irrigation canals, and other work judged necessary for the execution of the reclamation project. These firms will act as Government agents, purchases being made for the account of the Inspectoria, Equipment will be purchased, when necessary, by opening credits in New York. It is planned to begin construction as soon as equipment and men can be brought on the ground. Government funds for the completion of the project have been arranged At the present time the Federal Government has 40,000 contos cash allotted to reclamation work, and the remainder of the 200,000 contos appropriated will be raised by a 2 per cent tax on Brazil's gross revenue, which it is estimated will bring another 40,000 contos per year, thus the total amount will be available in four or five years



A home-made apparatus used for class-room demonstration of the frequency of an electric spark

Tylosaurus in life, as reconstructed by the Smithsonian scientists

An Extinct Sea Lizard from Western Kansas

By Charles W. Gilmore

THE chalk deposits of western Kansas have long been famous on account of the great number and the fine state of preservation of the fossil remains found in them For more than fifty years collectors of fossils have searched the chalk exposures for their hidden treasures Remains of fish large and small, turtles, toothed birds, lizards, both swimming and flying, and an occasional dinosaurian reptile have been the rewards of these indefatigable hunters

The United States National Museum numbers among its rarest treasures fossil remains of all of these several kinds of animals, but quite recently there has been added to the exhibition series the very fine specimen of a swimming or sea lizard shown in the accompanying illustration This animal goes under the name of *Tylosaurus proriger*, and belongs to a group of extinct reptiles commonly called Mosasaurs The mosasaurs were water living reptiles, with long slender bodies having the limbs modified into short swimming paddles, and a long powerful compressed tail with which they propelled themselves through the water This specimen, after many weeks of the most painstaking care and skilful work, was cleaned from the investing chalk, the broken parts repaired and the missing bones restored, until finally the skeleton was articulated in the pose shown It forms a wall panel, the skeleton being in half relief, the dark bone of the specimen standing out in bold contrast against the light yellowish color of the background, which has been made in imitation of the yellow chalk in which the specimen was originally found The pose adopted for the skeleton was largely determined by the curved articulated sections of the backbone as found in the ground

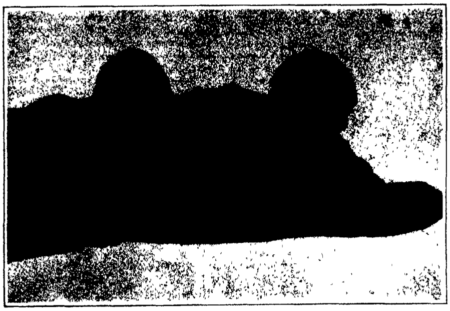
This specimen was collected for the National Museum by the veteran collector of fossils, Mr Charles H Sternberg, on Butte Creek, Logan County, Kansas, in 1917 Mr Sternberg and his three sons, all of whom have been raised as fossil hunters, have collected hundreds of these ancient monsters and the results of their discoveries are to be found in all of the principal museums of the world, the present specimen being still another contribution to the science to which they have given so much

The *Tylosaurus* specimen, as now exhibited, measures about twenty five feet in length, with a head that is three and one-half feet long The largest of the Mosasaurs, however, sometimes attained a length of forty feet, and such an animal would have a head fully five feet long Some of the small adult species were scarcely more than eight feet in length

The seas that rolled over Kansas in Cretaceous times contained thousands of these animals, and in the chalk bluffs of that region their remains are in such a perfect state of preservation that we are not only acquainted with their skeletal structure but with their external appearance as well Impressions made by the body in these soft sediments before decomposition had set in have been found, showing that in life they were covered with small overlapping scales In fact, small areas of skin impressions were found with the *Tylosaurus* specimen here discussed The most unusual discovery relating to the appearance in life of an animal long extinct, was the detection of color markings by

(*Continued on page 280*)

Skeleton of the fossil sea lizard being mounted for exhibition in the National Museum



Upper jaw, with teeth, of a Mosasaur from Alabama, a fairly close relative of the Kansas lizard

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Copyright Kadel & Herbert

Using the bayonet and scabbard to split wood for the small stove

A New Role for the Bayonet

INGENIOUS minds in Europe have been working overtime ever since the armistice was signed and hostilities ceased, developing all manner of peaceful uses for military equipment Many of these innovations and adaptations have been shown in these columns, and we have the bayonet wood splitter to add to our published collection This device consists of the standard bayonet scabbard, the bayonet, and two members which hold the bayonet and scabbard together and permit of mounting them on a wall all as shown in the accompanying illustration A number of notches cut in the front end of the scabbard permit of holding a piece of wood of any length in place while the bayonet does the splitting

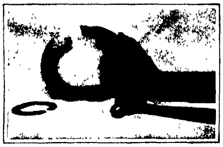
The Parachute Turned Toy

WITHIN the past month or two a new craze has sprung up in the ranks of Young America, namely, tiny parachutes which afford no end of amusement While there are several different makes of these diminutive parachutes on the market, the best one is made of a light silk like paper of extreme toughness It appears that these parachutes were used by United States Army aviators for sending down messages while in flight, and consequently manufactured in very large numbers Some enterprising person, knowing something about American boys and girls, undertook to dispose of the surplus paper parachutes to the toy stores From the very first the parachutes have taken the youngsters by storm

Waiting for a passing subway train to send a blast up through the grating for the toy parachute

The Come-Apart Washer for Quick Repairs

WHEN any part of a machine is to be repaired, the usual manner of mending that part is to take down the machine and reassemble it after the repair has been effected Today, in many cases machines do not have to be taken down and much time lost, especially when the repair is nothing more serious than placing a new washer on a shaft This saving in time and effort is brought about by a special washer which opens up so that it can be slipped over a shaft There are two designs of this washer, namely, one with a steel side-latch, and the other with a brass over-latch Latch and riveted parts are machine cut, which makes for a perfect fit The washer is closed by means of a light blow with a hammer or by using a hammer and punch on the top of the over-latch



A washer that can be opened and placed without the necessity of taking down a shaft

Trucks for Gas Rescue Service Work

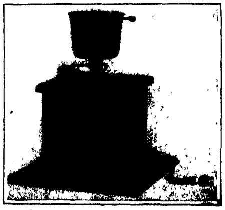
WHAT is claimed to be one of the best examples of standardized equipment in the service of a public service corporation is the fleet of light trucks for emergency work that has been installed by the Gas Company that serves Boston and a number of the surrounding municipalities The company has an emergency department that is as well organized as the fire department of any large city It is expected to safeguard the citizens against asphyxiation, explosions and the dangers that may develop from fire, and any of the crews must be ready to instantly respond to any form of call by day or night

The department consists of 15 crews of three men each, which are stationed in as many different sections of the city, as near the centers of the districts as is practically possible Each crew is provided with its own truck and responds to all alarms of fire in its district In addition it may be ordered to reinforce another crew in the event of conditions that one crew cannot cope with such as a large fire, an explosion, or similar disaster, prepared to shut off the gas supplies of buildings or areas, to resuscitate those who may be suffering from the effect of gas inhalation and each crew is subject to call for every gas leak of consequence in the district

The crews have fast, light trucks equipped with special bodies, these having been designed for the special needs of the service Each truck carries a pulmotor for resuscitation of persons suffering from inhalation of smoke or gas, two gas masks for working in dense gas, smoke or even ammonia fumes; every tool needed for emergency work on gas pipes and mains, including wrenches, bars, hammers, etc , two fire extinguishers, a ladder for descending into cellars, manholes and the like, ropes, chains, cable, rubber boots and coats and a first aid kit In addition there are electric torches and such materials as are necessary for making temporary repairs for practically any kind of a gas leak The equipment is stored in compartments which are quickly accessible and every part of the body is devoted to storage of useful apparatus and equipment

A Revolving Stand for the Christmas Tree

NOT satisfied with the plain wooden and metal stands used with Christmas trees an American inventor has developed the rather elaborate stand shown in the accompanying illustration The box contains an electric motor, which turns the shaft that carries the socket at the top of the box The electric light connection is made by means of a plug and connecting cord leading to the box, and coming out of the motor-driven shaft is a short connecting cord and socket, in which the plug from the Christmas tree lights may be plugged In this manner the electric lights are operated while the tree is turning without interference or interruption of any kind



A Christmas tree stand that revolves the tree while the lights are on

Motion Picture Portraits in Fifteen Minutes

A FILMLESS motion picture camera at first blush seems absurd because we are accustomed to associate film with motion picture photography But as a matter of fact there are various methods of motion picture photography which get along quite nicely without the use of film, using in its place glass plates, disks of transparent material, or even paper ribbons It is in the last-mentioned category that the present system finds itself

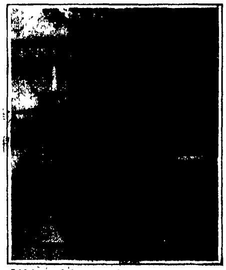
In order to produce motion picture portraits in small photographic studios without elaborate finishing processes, Mr Victor A Gianett, a Frenchman who is now in the United States, has developed the camera and paper "films"—if we may call them films for the sake of convenience -shown in the accompanying illustration The paper ribbon is exposed one picture at a time being passed through the camera mechanism by means of sprockets and an intermittent movement engaging with the perforations A developing tank is placed on the camera itself, so that the paper ribbon is developed and fixed without resort to the darkroom The result is a direct positive on bromotype paper and in true motion picture style

Copyright, Keystone View Co.

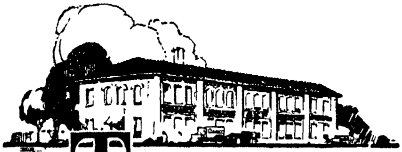
A camera which takes direct positive pictures on perforated strips of bromotype paper

Saving Time and Trouble with the Shop Floor Bucket

A NEW type of bucket for use in machine shops or foundries has been introduced by a Cleveland manufacturer The bucket is retained in a hole especially constructed for it in the floor of the shop and scrap is easily swept into it. Fitting over bucket is a cover of 5/16 inch steel plate which gives a level surface, permitting the operating of trucks over it when closed An overhead crane raises the bucket from the hole and it is carried to a storage dump where it is emptied or directly to cars which haul it away to the dumping place.



Lifting the scrap bucket out of its hole in the floor



SKF
Research Laboratory established at Philadelphia to co-operate with the Gothenburg Laboratories in the study of the American Manufacturers' friction problems

THE technical advice brought you by our engineers embodies the experience of highly trained organizations in all parts of the world in the solving of friction problems.

This international experience is both technical and practical and is acquired in co-effort with the best international research endeavor.

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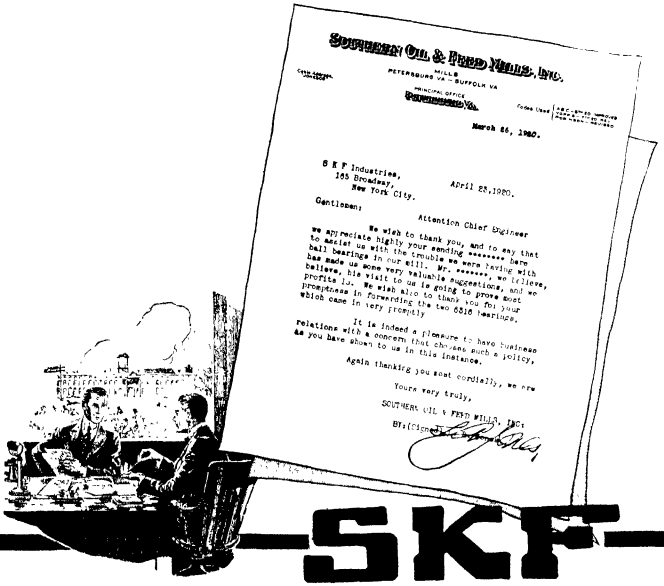


SOUTHERN OIL & FEED MILLS, INC.
MILLS
PETERSBURG VA – SUFFOLK VA
PRINCIPAL OFFICE
PETERSBURG, VA.

March 26, 1920.

S K F Industries,
165 Broadway,
New York City.

April 28, 1920.

Gentlemen;

Attention Chief Engineer

We wish to thank you, and to say that we appreciate highly your sending ******* here to assist us with the trouble we were having with ball bearings in our mill. Mr. ******, we believe, has made us some very valuable suggestions, and we believe, his visit to us is going to prove most profitable. We wish also to thank you for your promptness in forwarding the two 6316 bearings, which came in very promptly.

It is indeed a pleasure to have business relations with a concern that chooses such a policy, as you have shown to us in this instance.

Again thanking you most cordially, we are

Yours very truly,

SOUTHERN OIL & FEED MILLS, INC.

BY:(Signed)

Among these products now offered are:

Single row deep groove ball bearings. Thrust bearings. Steel balls.
Double row self-aligning ball bearings. Transmission equipment.

The Jewett Improved Angle-flow Bubbler Will Protect Health

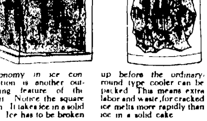
WATER spurts from the bubbler on the Jewett in a diagonal stream and it is impossible for anyone to drink directly over the bubbler The lips cannot touch the bubbler nor can any water drop from the mouth back into it and cause contamination It eliminates the germ spreading tin cups, dipper or glass, also the expense of paper cups Yet a glass can be easily filled from this angle-flow stream

The ice in the Jewett does not come in direct contact with the water It merely chills the coils through which the water flows. This precludes any chance of impurities in the ice getting into the water and insures just the right temperature—ice cooled water, not ice water that induces stomach disorders You safeguard your employees' health when you install Jewett Water Coolers

Selling Direct Cuts Costs

Jewett Water Coolers are sold direct to you from our factory. That means an appreciable saving on initial cost. Any handy man can attach it to your regular water supply.

The Jewett helps ward off the tiring, production-retarding effect of sweltering weather A post card mailed today will bring complete information on the Jewett Water Coolers.



Economy in ice consumption is another outstanding feature of the Jewett Notice the square design It takes ice in a solid cake Ice has to be broken up before the ordinary round type cooler can be packed This means extra labor and waste, for cracked ice melts more rapidly than ice in a solid cake

Size No. 1, $58 50 lbs. Capacity
Size No. 2, $75 100 lbs. Capacity

The Jewett Refrigerator Company
Established 1849
24 Chandler Street Buffalo, N. Y.

JEWETT
SQUARE WATER COOLER

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRSHIP—K A Enlund, c/o Greeley Chemical Co, 2126 Broadway, New York, N Y An object of this invention is to provide an airship, the construction of which will reduce the number of essential parts and will increase its strength and durability More especially the invention proposes an airship having rigid envelops or gas tanks certain of which are rotatable and provided with means so that upon their rotation they serve to drive the ship through the air, and to use propellers having the function also of sustaining the ship in the air

PROPELLER—B B Wood, Box 738, Minneapolis, Minn The invention relates particularly to airplane propellers, the purpose being to provide an air propeller having the desirable features of simplicity, durability and efficiency, and a propeller which is so constructed as to produce a forward thrust of great intensity to airplanes or other vehicles

Pertaining to Apparel

GARMENT—K Heitler, 605 W 141st St, New York, N Y The invention relates to a garment in which no draw strings or other encumbering device will be necessary at the waist portion The garment includes a body portion of elastic material, said body portion presenting an uninterrupted waist opening, an elastic band in intimate contact with said body portion, and attached to one of its faces and adjacent said waist opening

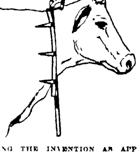
Electrical Devices

ELECTRIC HAIR SINGER—J P McMahon, 15 11th St, Whitestone, L I, N Y The object of the invention is to provide a hair singer using an electrically heated wire as the singeing medium to insure a quick and effective singeing of the hair Another object is to provide a simple construction and arrangement to prevent short circuiting through the medium of the hair or scalp

DRY BATTERY—B H Teitelbaum, address Bright Star Battery Co, 310 Hudson St, New York, N Y The invention has reference more particularly to a dry battery having zinc chloride as an ingredient in the electrolyte, also being provided with a valve arranged to allow the escape of the ammonia formed as the battery is used, but to exclude the air from said battery

Of Interest to Farmers

ANIMAL POKE—H Gerdes, Benkelman, Neb An object of the invention is the provision of a poke of simple and efficient construction which is formed with spurs mounted to automatically engage the neck of an animal when he attempts to force his way through a fence by means of a lever the spurs are so held that they will not engage the neck of the animal under normal conditions



SHOWING THE INVENTION AS APPLIED

HITCH FOR TRACTORS—G H Scanlan, 202 Fulton St, New York, N Y The invention relates to a hitch which will properly hold one or more implements in position to be moved by a tractor An object is to provide a hitch which is especially designed for connecting plows to the tractor, the construction being such that a ready adjustment may be secured for causing the plow to assume various depths while a proper strain is brought to bear thereon continuously

Of General Interest

COMBINATION STEEPER AND DIPPER—G H Nicholls, Box 536, Beaumont, Texas. The invention has for its object to provide a steeper and dipper adapted for use in making tea or coffee, wherein a perforated container is provided which is slidably connected with the pot at the axis thereof to move vertically to permit the tea or coffee to be supported in the water in the pot or out of the water.

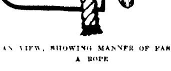
SAFETY RAZOR.—A C Knudtson, 920 Ave B, Bismarck, N D The invention relates to a safety razor comprising a relatively flat separable holder for a removable blade, and a rectilinear handle separate from the holder, and serving to secure the same in clamping relation to the blade, and in which displacement of the blade and clogging up of the holder and guard is positively prevented

INSULATING MATERIAL OR CONSTRUCTION—A Worthington, 322 E. 28th St., Brooklyn, N. Y Among the objects of the invention is to provide an insulating material, for use in connection with steam boilers or other analogous appliances, of maximum cheapness as well as efficiency, considering the strength or power to resist crushing strains or blows A further object is to provide an insulating material embodying a maximum number of air cells with respect to the body of the structure tending to resist crushing

FISHING NET—A Wolf, 251 8th Ave., Long Island City, N Y The invention has particular reference to hand operated devices in the form of nets commonly employed for crabbing or landing fish that are caught on hooks Among the objects is to provide a fishing net having a practically rigid frame adapted to be disconnected from the handle and folded so as to occupy a small amount of space

Hardware and Tools

FASTENING DEVICE—J H Pollard, 1183 Clay Ave Bronx, N Y The invention relates to a simple and convenient means for fastening the ends of ropes, cords, cables, chains and the like where it is desirable to make a fastening in a manner wherein it may be readily detached without the inconvenience of untying the knot A feature of the device is the various instances where it can be advantageously used, and the low cost of manufacture



A PLAN VIEW, SHOWING MANNER OF FASTENING A ROPE

ADJUSTABLE TUMBLER LOCK — F Clark, c/o R A Day & Co, Apartado 91 Bis, Mexico City Mexico Among the objects of the invention is to so construct a lock of the combination type that it will easily get out of order, and to provide a lock of simple construction, having few parts, compactly arranged, and which may be inexpensive to manufacture A further object is to provide a lock which may be actuated by the mere insertion of a key

Heating and Lighting

AUTOMATIC WATER HEATER.—G S. Walker, 325 Atwood St., Pittsburg, Pa. The object of this invention is to provide a water heater whose automatic action is dependent upon the differential action of two thermostats, with the intent of eliminating the piston water valve which it is the custom to use in heaters of this type, but which frequently stick and cause accidents or put the heater out of commission A further object is to eliminate stuffing boxes, glands, etc, and to provide a heater which is simple, safe, and economical in the consumption of gas.

Machines and Mechanical Devices

CORING MEANS FOR TOMATO PEELING MACHINES—C Kibing, P. O. Box 418, Ogden, Utah The invention relates to means for coring the tomatoes after the skins are removed The general object is to effect the step of coring the tomatoes by means embodied in the holders on which the tomatoes are impaled and carried about the machine, said means being arranged to be operated by coacting fixed means on the machine, whereby to eliminate the use of separate coring mechanism

Medical Devices

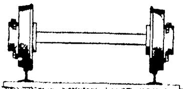
TONGUE SHIELD—G Guise, Riley, Ind The invention relates to a tongue shield for use in taking medicine; the shield consists of a liquid proof material, the front portion being tubular to accommodate the tongue, the top presenting an area to cover and shield the gustatory area of the tongue

Prime Movers and Their Accessories

MOTOR.—P. C. Clark, 446 N. 2nd St., Montrose, Colo This invention has for its object to provide a motor operated by the flow of water for supplying a portion of said water to a reservoir or the like, wherein a rocker is provided adapted to be rocked by the flowing water, the rocker operating means for diverting the water to the opposite side of the rocker to cause the rocker to rock, the rocker being connected to a pump to operate the same when it is rocked.

Railways and Their Accessories

CAR WHEEL AND MEANS FOR MOUNTING THE SAME—G. E Pratt, 621 Summit St, Pueblo, Col. The object of the invention is to construct a car wheel and method of mounting the same to an axle which is particularly designed for use in connection with small cars, such as mining cars, but which may be readily designed so as to meet the requirements of a large type of car A further object is the construction of an axle which will have a life equally as long as that of the car and which will not have to be machined



AN AXLE AND WHEELS DESIGNED ACCORDING TO THE INVENTION

Pertaining to Recreation

GAME APPARATUS—T A Y Hodgson, Palmerton, Pa The object of the invention is to provide a game apparatus, which includes a game board having indicated thereon the directions of movements of the different types of pieces, the indications on the game board corresponding with the indications on the different types of pieces

Pertaining to Vehicles

TIRE RIM TOOL—H H Fischer, c/o B F Patschke, 7th and Guilford St., Lebanon, Pa. The invention relates to appliances for removing a split demountable rim from a tire or replacing the rim on the tire The object is to provide a tool which is simple and durable in construction, easily placed in position and arranged to require comparatively little physical exertion on the part of the user

TIRE DEFLATION INDICATOR—E O Carvin, Box 382, Nevada City, Cal The object of the invention is to provide mechanism for use in connection with the tires of motor vehicles, for indicating by means of a signal when the tire is deflated beyond a predetermined point, the signal being controlled into operation by the deflation of the tire, and operated by the rotation of the wheel of the tire either in forward motion or in the reverse.

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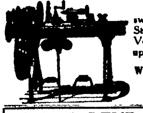

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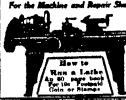

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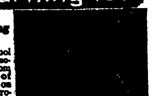

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[illegible] Los Angeles, Cal.

Twelve Hundred Charts at a Third of a Cent

(*Continued from page 264*)

Great Britain for more than twenty-five per cent of its charts.

In November, 1914, the following notice was sent out from the British Admiralty chart agent.

"I am instructed to give notice that no supplies of Admiralty charts are to be made without authority to any European countries, or subject of these countries, with the exception of France, Russia, Greece and Portugal. Applications for charts from all other parts of the world are to be submitted for consideration. Further, no sales are to be allowed to any customer until the *bona fides* of the purchaser has been satisfactorily proved and a certificate stating the name of customer, nationality, service, and ship or shipping company, for which the charts are required, has been received"

Suppose the date to be 1921 instead of 1914 Suppose, instead of being an ally of England, England stood aloof, and sold charts neither to us nor to the Fiji Islands if we were at war with them? It will not do to say that we have copies of all charts Great Britain has issued. So we have. But we have not enough Charts wear out quickly in use For every ship there must be a full outfit of charts for every locality she can possibly need to visit

From the standpoint of economy, it is far cheaper for us to reproduce a chart and sell it at cost, than to buy it from Great Britain But this is not a matter of economy Whether we spend a hundred thousand dollars in ten years buying charts from Great Britain for naval use or three hundred thousand in five years reproducing those charts so that we are forever independent of Great Britain—and of the items of time of transportation and time of manufacture—is not important from the dollar side It is vitally important from the naval efficiency side

The war taught us something of what unpreparedness meant It gave to us all the full knowledge of how useless were guns without men, men without clothes and food, clothes and food for men abroad without ships to carry them In any war not fought at home, the vital factor, the underlying, dominant thing by which a war is lost or won, is transportation And transportation at sea is either a leap in the chartless dark or a reasonable hazard if the ship has the knowledge of reef, shoal current, depth, bottom, lights, buoys, which can be obtained from charts and only from charts.

We have the most able chart makers in the world We have a navy which is second to none in quality and second to but one in size We have the money, the men, the will, to be invincible in defense. Are we to continue to stultify all that we are, and all that we have spent, by lack of charts? Or will we who do not go down to the sea in ships, but who have both a wholesome admiration for, and an utter reliance upon, our navy, see to it that our legislative body does not deny this necessary expansion to our naval munitions program?

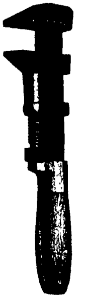
When Humpty-Dumpty Travels

(*Continued from page 265*)

or a quarter-sized honeycomb for the bottom layer as a cushion. If these become only slightly damp they collapse and are useless

The express company now requires that pads of excelsior be used on top of and beneath the half-cases of eggs as a buffer It is recommended that a third pad be placed between the two top layers of eggs, as these are most often broken.

It is a well-known fact that even a strong man cannot crush an egg if he applies his strength evenly on the ends But it does not take much strength to crush an egg if pressed on the side. The best of the new egg containers take advantage of this principle and the egg



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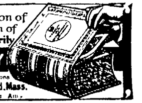

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when packed is literally suspended under tension between two flexible holders which grip the ends Thus held it is almost impossible to break the egg, short of wrecking the case itself

But an ideal egg container must have other qualities It must, first of all, be cheap Many of the best containers are of very little practical value because they are of complicated structure and too expensive to manufacture Another desirable feature which is usually overlooked by the inventor is the need for removing the eggs easily and rapidly Where large quantities of eggs are handled this is an important factor and is one of the chief reasons for reluctance in giving up the old containers. In such operations as candling, repacking, etc, the worker simply lifts out the honeycomb and picks up the eggs In some of the newly devised containers, it is necessary to pick up each egg individually and sometimes they are hard to grasp Another desirable feature is that the container be able to stand more than one trip without breaking down in a vital spot Finally, the container which confines a broken egg to its own compartment adds a point in its favor

There is not yet on the market or, so far as the writer can ascertain, in existence an egg container which has all of these qualities So the "perfect" method of shipping eggs is yet to be found but at least two of the containers now available, one of which is already on the market, seem to meet all normal requirements

It is related that recently a carload of eggs was wrecked and an experienced freight estimator reported the probable damage to the eggs at $1,000, supposing that the standard packing methods were used It happened that the eggs were packed in one of the new style containers and an examination of the contents of the car showed an actual damage of $10 This is not surprising when the laboratory tests of this particular container are compared with those of the honeycomb type

Only one of the new containers has seen any wide introduction so far, but it has met with such success that experts believe the ancient prestige of the honeycomb filler has at last been seriously challenged And one of these happy days, they believe Mr Ultimate Consumer will no longer have to foot million dollar bills for broken eggs

The Why of Luminous Paints

(Continued from page 265)

explained here that what we really see is the phosphorescent glow of zinc sulfide (crystallized zinc) and not the radium

Light has the effect of actually altering the structure of certain substances That is the cells or crystals which compose the substance are stressed by light so that they change their shape and this change sometimes changes the properties of the material The action of the selenium cell by means of which it is possible to transmit photographs by wire, depends upon this principle In this case the change in the crystalline structure of the metal affects the electrical conductivity

A similar change takes place in all of the so-called phosphorescent substances The cells, distorted by light have an elastic quality and when the light is removed gradually resume their normal shape and in doing so give off light This light gradually dies away as the crystals approach normal and the light they give, at best, lasts but an hour or two

The curious thing is these phosphorescent substances behave in the presence of radium exactly as though they were exposed to light The most sensitive to the presence of radium so far discovered is zinc sulfide and for this reason it is used as the base of all the commercial luminous materials

Only a very minute quantity of radium is required In fact, while the world production of radium is now nearly an ounce a year, only about 5 per cent of this production is used to illuminate the millions of watch and clock dials, instru-

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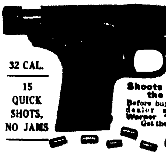

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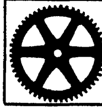

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[illegible] New York

To Readers of Scientific American Monthly

Copies of February, 1921, issue of Scientific American Monthly, now out of print, are desired by the publishers, [illegible]

ment dials, buttons, locators, etc. Something of the terrific power of radium can be realized from this fact.

In fact the smaller the amount of radium used to secure a given luminosity, the better the substance. For the powerful radium rays gradually destroy the structure of the zinc crystals and they lose their phosphorescent quality. The chemist's problem is to produce a phosphorescent substance which will stand up longest under the terrific bombardment of the radium rays and which, at the same time, will give off the most light. Such progress is being made in this direction that today only about one-twentieth the amount of radium used four years ago is needed in the making of luminous material. And the chemist insists that he has only scratched the surface of possibilities in this direction and that even better results can be attained. At present the life of the zinc crystals is from 15 to 20 years, although the radium lasts for centuries.

Because of the supreme importance of the zinc sulfide, it is extracted in the same factory and under the same precision control as the radium itself. It must not only be chemically pure, but the crystals must be perfectly formed. The perfect crystal is an elongated hexagon. When viewed under the microscope in the presence of radium the crystal has a slightly irregular shape and is surrounded by a sort of halo of light.

The zinc sulfide is tested for endurance by subjecting it to a high-frequency electrical current. The current is carefully gaged and by observing when the crystals break down the life of the material in years in the presence of a given quantity of radium can be accurately foretold.

This life will be much longer if the instrument to which it is applied is kept away from the light much of the time. The crystals, already stressed by the radium rays, have an additional strain imposed by the light and this hastens the process of disintegration. Strong sunlight, especially at the seashore where the presence of much ozone in the air intensifies the ultra-violet rays, has a very destructive effect on luminous material. For this reason the manufacturers of this delicate substance usually guarantee it for about half its normal life, or ten years.

Both the luminosity and the life of the substance may also be affected by the manner of application. Only the purest of adhesives are used and the luminous material, in the form of a fine yellow powder, is mixed in a little bowl in very small quantities. Care is taken in mixing not to crush the tiny crystals. The application to the object to be illuminated is made with the tip of a fine brush, the material being deposited in little drops until the surface is covered. Should the material be brushed on, the crystals would suffer and both the life and the luminosity would be lessened.

Of all manufactured substances radium luminous material is perhaps the most delicate and most sensitive.

Making the Most of Niagara

(Continued from page 266)

then, after reaching the crest of the structure, glide down the rear slope and back into the sweep of the river. The descending ramp will prevent the ice from dropping sheer on to the riverbed and thus obviate any undermining of the dam. Further, the modeling of the dam is one that can be counted upon to make an ice jam well-nigh impossible.

The dam will serve the double purpose of impounding the waters of the Niagara for a distance of nearly 6 miles and of housing the great turbo-generators that will transform the force of these waters into 2,500,000 horsepower of electrical energy. According to the estimates, this undertaking would involve a total outlay of approximately $100,000,000; and from start to finish would take something like three years. On the basis of coal consumption previously cited for the devel- [illegible]

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Buy a tube of Shavaid at once from your druggist. Try it. You'll be delighted.

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Reduced working schedules bring home the fact of what can be done with fewer operatives and *Veeder Counters* on machines. A man will attend to a larger share of the production; will work to prove his right to be retained, when you see his product daily *recorded* on a

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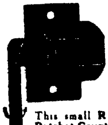

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required in recording the product of the smaller stamping presses. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adaptable to no end of small machines, simply by regulating the throw of the lever. Price $2.00
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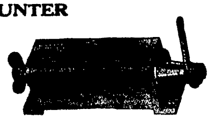

This large Set-Back Rotary Ratchet Counter records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation. Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Provided with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50 (List.) Equipped with lock and keys to prevent tampering with the record, $2.00 extra
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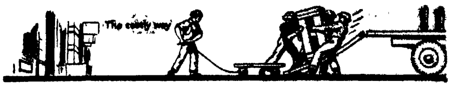
The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.



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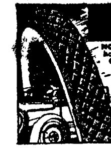

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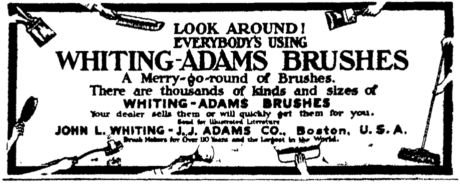

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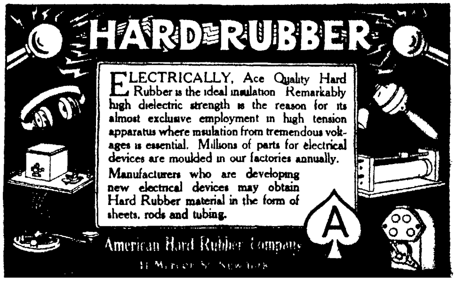

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Manufacturers who are developing new electrical devices may obtain Hard Rubber material in the form of sheets, rods and tubing.

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opment of a horsepower year, [illegible] tons, this scheme would be tantamount to saving 16,000,000 tons of that fuel annually. At $10 a ton this would represent an economy of $160,000,000 every twelvemonth. But quite apart from these considerations, there would be that inestimable gain in the matter of electrical energy that could be utilized for innumerable industrial purposes. Not only that, motive impulse at a moderate cost would be available for domestic services of many sorts.

We have led the world in the varied character and the magnitude of our electrochemical industries, and we can maintain our position in this respect only by continuing to provide great blocks of low-priced current to meet the increasing demands for the commodities now manufactured at or near Niagara Falls. Finally, let it be recalled that the two projects might prove exceedingly valuable sources of energy for that great superpower zone which is to embrace a far-flung section of the States of our northeastern seaboard. Isn't it worth our while to have at our disposal 3,500,000 horsepower without burning a single pound of coal? Can we be indifferent to undertakings that will enable us to increase vastly our productiveness while cutting the fuel bill by hundreds of millions of dollars yearly?

The Musical Hospital

(*Continued from page 270*)

Once in the hand of the violin doctor the broken pieces are tenderly taken out of the paper and an account of stock is taken to see what is missing. If the cracks are small they must be encouraged to open so a little glue can be introduced and they are then tightly bound until dry. If the wound is more severe the cracks are taken up by inserting a narrow slip of wood with plenty of stock left on the inside to shave off when dry. Small squares or "reinforcement blocks" will be noticed up and down the back and belly; these are minute plugs inserted to help fill the crack and the square tops will be planed off before gluing together and varnishing. After all traces of the accident have been obliterated the instrument is carefully assembled and glued together, complicated clamps holding it in position during the drying operation, which is never hurried. Finally, the varnish is applied and the instrument is put away in a glass case out of the dust and in a few weeks the owner almost tearfully tests its tone and goes his way rejoicing

The Heavens in April, 1921

(*Continued from page 272*)

Draco is high in the northeast, with Lyra below and Cygnus rising. High in the east is Bootes, with Corona and Hercules below and to the left, and Ophiuchus rising to the right. Virgo is well up in the south with Hydra below and extending far to the westward.

The winter constellations are almost gone. Orion and Taurus have set, and only Canis Minor, Gemini, and Auriga remain in sight. Leo, high in the southwest and brightened by the presence of Jupiter and Saturn, completes the list of conspicuous objects

The Planets

Mercury is a morning star all this month, but is best observable at its beginning, when he rises a little before 4 A. M. and should be easy to see. Venus begins as an evening star setting at 9 P. M. on the first, and appearing as a very beautiful crescent with so small an instrument as a powerful binocular; but she moves very rapidly into line between us and the sun, reaching her conjunction on the 22nd, so that during the last half of the month she is practically invisible.

Mars is an evening star in Aries, but is pretty low. On the 4th he is in conjunction with Venus; but as the two planets are 7½ degrees apart in declination, the phenomenon will not be striking.

Jupiter is in Leo, and is admirably observable [illegible] 9 P. M. in the middle of the month. Saturn is in the same constellation about eight degrees farther east, [illegible] likewise conspicuous. With a powerful telescope he is an exceedingly interesting object. On April 19th the rings are turned edgewise toward the sun, and after that date we shall be looking at their dark side until the end of July, and they will be quite invisible except in the most powerful telescopes, which will show them as a faint, ghostly line, illuminated partly by light reflected from the planet and partly by sunlight transmitted through the interstices of their particles.

Uranus is a morning star in Aquarius, rising about 3:30 A. M., while Neptune is in Cancer, and comes to the meridian at 7:30 P. M. in the middle of the month.

The moon is new at 4 A. M. on the 8th, in her first quarter at 5 A. M. on the 15th, full at 2 A. M. on the 22nd, and in her last quarter at 11 P. M. on the 29th. She is nearest us on the 16th, and farthest away on the 1st and 29th. During the month she passes near Uranus on the 5th, Mercury on the 6th, Venus and Mars on the 9th, Neptune on the 16th, Jupiter on the 18th, and Saturn on the 19th.

The month is notable for two eclipses, of the sun on the 8th and of the moon on the night of the 21st-22nd. The latter is visible throughout the United States and we shall describe it on the notes page next week. The solar eclipse on the 8th is annular, and visible in Europe—also, as a partial eclipse, in northern Africa, western Asia, and Greenland. Eclipse expeditions are not usual when the eclipse is only annular, but this time Dr. Fotheringham [illegible] to go to see whether any stars are visible with the naked eye during the semi-darkness of the annular phase, hoping thus to obtain information of value in the interpretation of ancient and medieval eclipse records.

At sea, S S. "Aquitania,"
March 17, 1921.

An Extinct Sea Lizard from Western Kansas

(*Continued from page 273*)

Doctor Williston, who observed on one specimen carbonized pigment, which showed that the sides of the body were marked by narrow, diagonally placed parallel bars.

One of the unique features of *Tylosaurus*, and for that matter of all mosasaurs, is an articular joint in about the middle of each lower jaw, which permits considerable movement between the front and back parts, both up and down and sideways, though chiefly in the latter direction. This feature in conjunction with their very loose attachment to one another at the forward ends allowed the jaws to expand and thus enabled them to swallow large objects, for it is certain that not all of the animals which the *Tylosaurus* devoured were small, for since their teeth were not adapted for the rending of bodies they must have been swallowed whole.

While most of the Mosasaurs were predatory animals having the jaws provided with numerous sharply pointed teeth that were well adapted for catching fish—for it is thought fish formed their principal article of diet, since fish bones and scales have been found among the fossilised stomach contents—there was another kind of Mosasaur, *Globidens alabamensis*, that formerly lived in North America and enjoyed quite a different kind of food as shown by the very peculiar shape of its teeth. Reference is made to a specimen in the National Museum found some few years ago in the northern part of the State of Alabama which has nearly spherical teeth.

Mosasaur specimens have not only been found in many parts of the United States, but in South America, Belgium, Holland, Russia, France, [illegible] New Zealand, but nowhere are [illegible] abundant or are their [illegible] more [illegible] state of preservation [illegible] in the [illegible] deposits

IN THIS ISSUE:
RAILS AND RAILROADS
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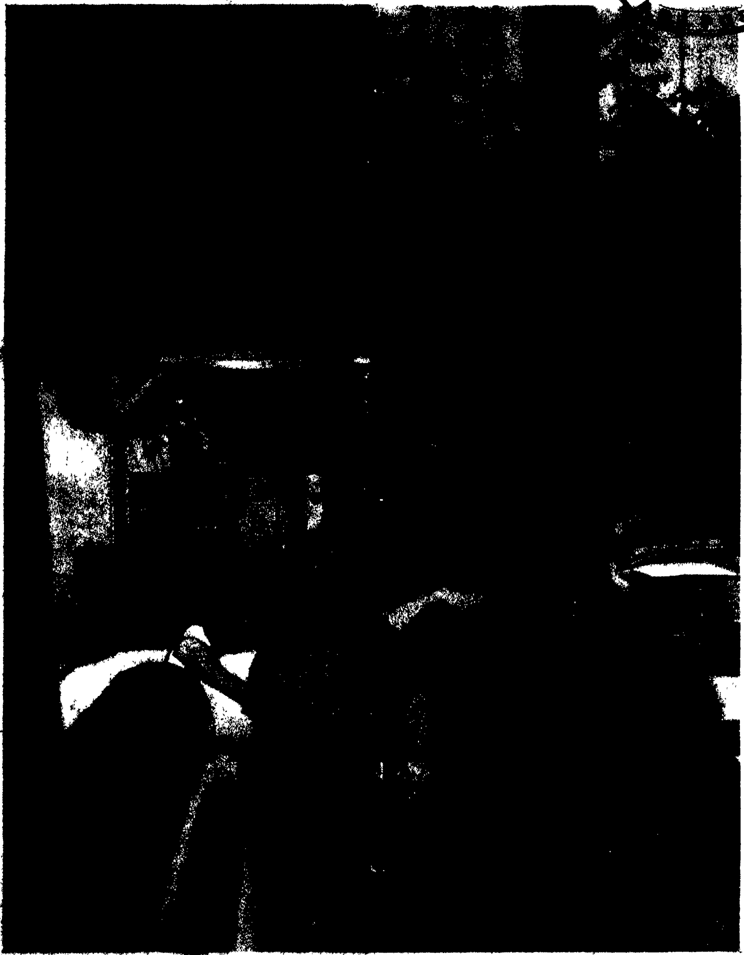

LOGGING WITH THE AID OF THE ELECTRIC YARDER AND DUPLEX LOADER.—[See page 285]

[illegible]

Published Weekly by
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20 cents in Canada

"Medium" Oil from Nine Garages

And no two alike!
The high cost of asking merely for "light," "medium" or "heavy" oil

A MOTORIST bought nine separate quarts of oil from nine garages. In each case he asked for a quart of "medium" oil. The samples were sent to us for analysis.

No two tested alike, either in body or character.

A vital point in automobile lubrication is involved.

Assume that one of these "medium" oils was correct for that man's car. Then in body the other eight were certainly incorrect. Their use would lead to wasted gasoline, wasted oil, loss of power and all the effects of incorrect lubrication.

One manufacturer's "light" is often another's "medium." A third manufacturer's "medium" may be a fourth manufacturer's "heavy." No central authority sets definite standards for oils so classed.

Furthermore: Under the heat of service many so-called "heavy" oils become thinner than many so-called "medium" grades

The motorist who buys oil in this hit-or-miss way is certain to get hit-or-miss compression and hit-or-miss protection.

* * *

WE PRODUCE Gargoyle Mobiloils in several grades. We mark these grades with letters or symbols — "A", "B", "E", "Arctic." The grade which is of the correct body and character for *your* car is plainly indicated on our Chart of Automobile Recommendations. To use any other grade of Gargoyle Mobiloils than that specified for your car in the Chart is a mistake.

When you use the grade of Gargoyle Mobiloils specified for your car in the Chart, the oil in your crank-case does not vary from day to day or week to week. You get uniform protection, full compression and consistent performance. You get true economy of upkeep and operating costs.

To buy your oil in any other way is to invite wasted gasoline and other unnecessary expenses.

If your car is not listed on the partial Chart to the right, send for our booklet "Correct Automobile Lubrication," which contains the complete Chart. Or consult the complete Chart at your dealer's.

In writing, please address our nearest branch.

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Mobiloils

A grade for each type of motor

Chart of Recommendations
for AUTOMOBILES
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GARGOYLE

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A grade for each type of motor

How to Read the Chart

THE Correct Grades of Gargoyle Mobiloils for engine lubrication are specified in the Chart below.

A means Gargoyle Mobiloil "A"
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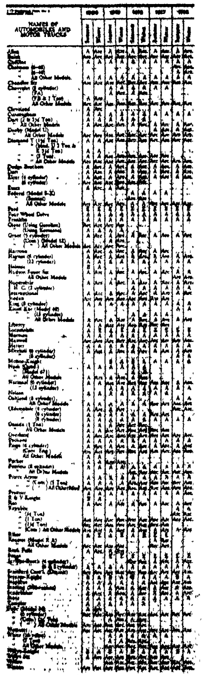
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

These recommendations cover all models of both passenger and commercial vehicles unless otherwise specified.

Where different grades of Gargoyle Mobiloils are recommended for summer and winter use, the winter recommendation should be followed during the entire period when freezing temperatures may be experienced.

This Chart is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and constitutes a scientific guide to Correct Automobile Lubrication.

If your car is not listed in this partial chart consult the Chart of Recommendations at your dealer's, or send for booklet, "Correct Lubrication," which lists the Correct Grades for *all* cars.



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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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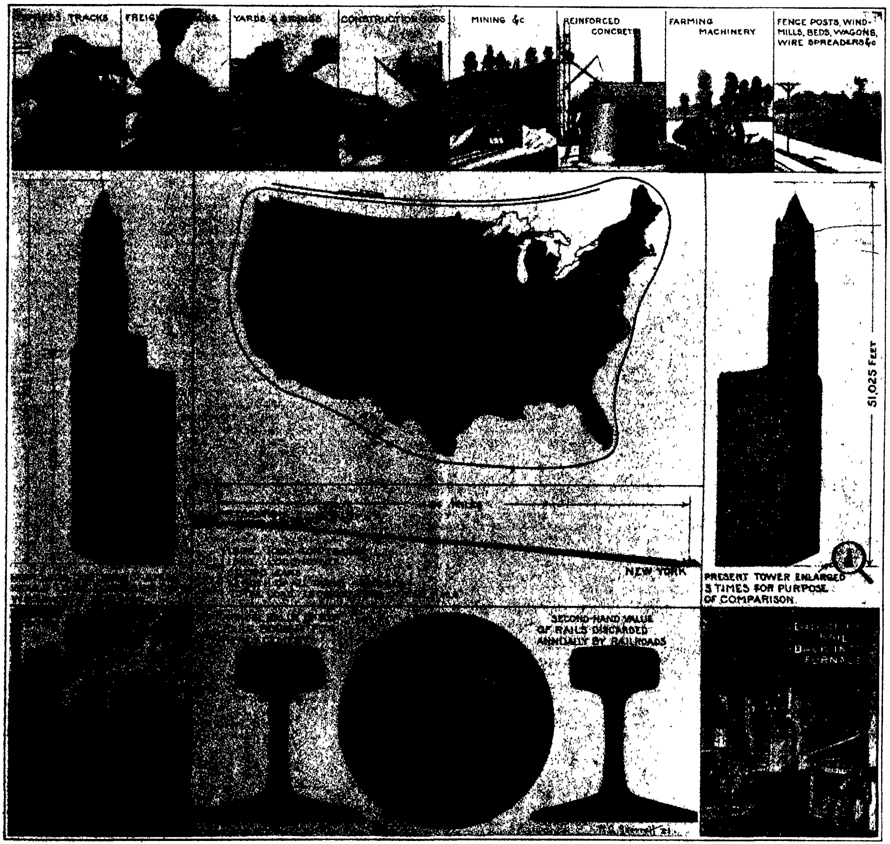
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The top row of pictures shows the life history of a typical steel rail from the time it is pressed into service on the main line of a railroad, until it terminates its career in such forms as fence posts windmills, beds, wagons, wire spreaders and so on. The map of the United States shows the mileage represented by our annually relaid tracks - sufficient mileage to make three and a fraction tracks across the United States, or sufficient mileage to go around the United States with a good deal to spare. The comparison given below the map shows how many cars and locomotives would be necessary to move 1,500,000 tons of new steel rails. Other drawings show the volume of steel involved in this work in comparison with the Woolworth Building

The story of the steel rail of American railroads and the yearly traffic in new and old rails—[See page 287]

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Army Engineers Report Against Ocean Ship Canal

THE Chief of Engineers of the Army was ordered in the River and Harbor Act of 1919 to report on the feasibility of an ocean ship canal between the Great Lakes and the Hudson River After investigation, the Army Engineers having charge of the survey have reported against the project and the report is endorsed by the Chief of Engineers Major General L H Beach

This is no new subject It has been investigated many times since the first report was made in 1832 There are three practical locations between Lakes Erie and Ontario, namely, the Welland Canal in Canada, and in America, the routes from Tonawanda to Olcott and from LaSalle to Lewiston Between Ontario and the Hudson River a ship channel could be dug along the route of the existing New York State Barge Canal from Oswego to the Mohawk Valley, and down the Valley to the Hudson, or from the St Lawrence to Lake Champlain and thence by ship canal to the Hudson

General Beach states that the value of a ship canal depends mainly upon how much of the present hundred million tons of Lake commerce would be moved through the canal, and what saving of freight charges would be effected He reaches the conclusion that it is not feasible for the United States to build such a canal at the present time He considers that the present State Barge Canal has not been open for navigation a sufficient time for business interests to accommodate themselves to its use, and that as yet it is too early to determine definitely what its commercial influence will be The 160 million dollars spent upon the Barge Canal would be lost if a ship canal were built Therefore he recommends that any consideration of the construction of a deep-sea canal be abandoned until the actual completion and use of the large Welland Canal, and the actual demonstration of the inadequacy of the New York State Barge Canal indicate a need for such a ship canal

The Battle of the Brakes

FRANCE has been the scene during the last few weeks of a contest between the leading types of train brakes in which our own Westinghouse brake has been a leading factor and promises, indeed, to be the deciding factor The ever-increasing power of locomotives and length of trains developed a problem of train braking which became so serious as to demand a quick solution The older type of pneumatic air brake was set by the opening of a continuous train pipe which extended throughout the train This reduced the air pressure and allowed the brakes to function The release was effected by the engineer at the head of the train and while the brakes were supposed to be set simultaneously, as a matter of fact the reduction of air pressure was gradual from the front to the rear of the train, the brakes being successively set at very slight intervals of time This was not serious in the shorter trains of an earlier period, but when trains began to run to lengths of 35 to 60 cars, trouble developed The momentum of the unbraked after portion of the train brought excessive strain upon the center cars, and occasionally would cause the buckling of the train and derailment The trouble was remedied by introducing the pneumatic electric brake by which the engineer was able to open the train pipe at each car simultaneously

The French Government has instituted a competition with a view to selecting a standard type of brake for all the governmental railroads The Westinghouse brake has been used for many years on that splendid system known as the Paris, Lyons and Mediterranean Railroad It has proved entirely satisfactory This experience has been confirmed in the tests which have been recently held The closest competitor is the type of brake which has been used successfully on the Paris subways, but it is stated that when the brake was tried out on a long mixed freight train running at fifty miles an hour, several cars were injured The German Kunz Knorr brake, which is used on several of the German railroads that cross the frontier is not adapted for use with the Westinghouse and other types of brake, and trains crossing into France have to use the hand brake It is believed in France that the adoption in that country of the Westinghouse brake will lead to its use in Germany and ultimately throughout Europe

Ships Stay Too Long in Port

THE average man thinks of a ship as engaged in sailing the high seas with occasional and brief interruptions when it is in port Quite a mistaken idea, for the average ship spends as much time in port as she does at sea Indeed, in times of depression such as we are now passing through, she spends much more of her time in port than at sea

Since a ship is a means of getting goods from one place to another, she is in a sense profitably employed only when she is moving as her receipts are in proportion to the distance over which these goods are moved Since all the overhead and crew charges continue to accumulate while the ship is in port, manifestly everything possible should be done to cut down the time spent in loading and unloading and in the necessary ship repairs For lack of a sense of proportion men have busied themselves with one half of the problem to the neglect of the other half We have given most of our effort to perfecting the ship and too little to perfecting the pier, dock warehouse and mechanical appliances which determine the length of time the ship spends in port

In this connection much interest attaches to a paper on the functions of the merchant ship, read at the last meeting of the Institution of Naval Architects by Sir Norman Hill, in which he protests against the statement that time in port is lost time, pointing out that loading and discharging are just as necessary as the transportation of cargoes—a fact which ought to be self-evident He makes the point that the over all efficiency of a ship is composed of several factors and that, after safety, the most important of these is time, since in measuring efficiency, it is the life of the ship and the total of the cargo she will carry that are always to be kept in view

In endeavoring to gain this efficiency, the naval architect must have in view first safety, for commerce profits nothing from lost cargoes As to speed, the author of the paper argues that little is to be gained from increasing the speed with which any voyage is made, and he brings out the surprising fact that during the past thirty years there has been a negligible increase in the average speed of ships of the British mercantile marine Lloyd's statistics show that the average speed of vessels of twelve knots and upward was 13 9 knots in 1894, and in 1908, when the tonnage had nearly tripled, the average was only 14 knots The average speed of all ships, fast and slow, is estimated to have been in 1894, 10 4 knots and in 1908, 11 knots Altogether, the author of the paper believes that the average speed of British steamships has not increased during the past thirty years more than about half a knot

Evidently, if any considerable amount of time is to be saved it must be saved in port

Although much has been done in the design of loading and unloading machinery, particularly for ships carrying freight in bulk, for ships carrying special commodities and mixed freight there is still room for great improvement In studying the problem, certain tendencies are to be noted First, there is the growth in size of the ocean-going steamship In 1860, the average size of the British steamship was 2,200 tons gross In 1890 it was only 2 600 tons, but in the next ten years it increased to 3,500 tons, and in 1910 it was 4 000 tons Undoubtedly, today it is very much larger. There is to be noted a concentration of trade in a limited number of ports, of which London and New York are the most marked examples. Another tendency—very important as affecting expeditious handling of cargo—is the growth of what is called "parcel shipments," and the decrease of "whole cargoes." General trade both import and export is depending more and more on the liners which carry mixed cargoes. Safety and regularity of voyages enable the manufacturer and retailer to buy almost direct from the producers in all parts of the world. International trade is carried on borrowed money, and while in transit almost all cargoes are the properties of the bankers and financial houses The effect of all these tendencies is to concentrate the general ocean overseas trade in the ports which can offer the best accommodations to the bigger ships, both as regards berthing and the handling of their mixed cargoes Unfortunately, as regards the length of stay in port, this concentration works against the quick turn around of these ships These observations have a decided significance for the leading ports of our own seaboard, where the same causes will increasingly produce the same results when the present depression passes and trade begins to flow in volume through its accustomed channels

Results in Our Reclamation Service

IT is now some eighteen years since the Reclamation Act for the recovery of the semi-arid lands of the West was passed, and although the work was planned on an unprecedented scale of magnitude progress has been uninterrupted and the economic results as shown in the last report of the Secretary of the Interior are highly satisfactory To date twenty-four primary and four Indian projects have been completed, or partly completed, at a net cost of 125 million dollars, and in the fiscal year ending June 30, 1920, the value of the crops grown on these projects amounted to 153 million dollars

Although the great fertility of the lands thus recovered by irrigation is proverbial, the following statement of the yields per acre in the various districts will be surprising to anyone who is not familiar with the details Thus we learn from the report that the crop values in excess of one hundred dollars per acre are as follows; In the Salt River project, $126 27, Yuma, $134, Yakima, Sunnyside Unit, $167 07; and on the Okanogan project the yield reached the astonishing figure of $367 23 The annual farm census of the Reclamation Service shows that the value of products on reclamation projects of nearly $80 per acre is twice as large as the average yield of unirrigated land in the humid regions of the United States

The statistics of increase show that there was a growth of irrigated acreage of from 694,142 acres in 1913 to 1,187,255 acres in 1919 In the same period the crop value has risen from $15,676,411 to $88,974,137 A serious problem has developed in the matter of providing adequate drainage to prevent seeping and water-logging of the soil and the deposition of alkali It can be solved, but we learn that a considerable portion of the funds must be employed in the construction of drainage work

The wisdom with which the scope and plan of operations of this great Federal work were planned is shown in the case of the Salt River project, which reported a total crop value of 23 million dollars. This is twice what the Water Users' Association must repay to the United States over a period of twenty years, moreover, most of this money will be derived from the power profits from the various hydroelectric works that form part of the system On other projects the actual crop value is comparable to the cost of building the irrigation works which have made these crops possible

The proportional distribution of the crops places alfalfa in the lead with 40 per cent of the cropped acreage Next is wheat with 15 per cent. Pastures represent 10 3 and cotton 9 7 per cent. In spite of this favorable showing, it has been impossible to undertake new projects because of the lack of funds

The shortage of funds is due, in part, to the falling off in the receipts from the sale of public land. Another drawback has been the setting aside (as provided by the Act) of $1,000,000 annually to repay advances made from the revolving fund of $20,000,000. However, it is probable that many millions of dollars will be transferred to the Reclamation Service, in accordance with the Act of Feb. 25, 1920, covering the leasing of mineral lands.

Electricity

An Electric Egg Beater is the latest electrical appliance for the home. This device consists of a small electric motor which drives a pair of blades through suitable gearing. The device is provided with a handle so that it can be conveniently handled and tilted to any angle. A control lever starts and stops the motor, and regulates the speed of the blades or paddles as required. The gears and bearings are of bronze.

An Electric Invalid Chair has been developed in France with specifications as follows: ¼-horsepower electric motor, controller which provides four speeds forward and reverse, worm drive to front wheels, special leaf and C springs, pneumatic-tired wire wheels, and storage battery with a capacity of 20 ampere hours. Particular attention has been given to suspension. This chair has been produced to replace the manually-driven type, and in consequence of the demand for invalid chairs for war invalids.

Reproducing Speech with Galena Crystals.—As far back as 1913 Brazier and Dongier showed that the passage of a sufficiently strong alternating current across the surface of contact of a metal point with a crystal of galena caused a sonorous effect P. Collet, writing in *Comptes Rendus*, tells of his experiments along this line By using an undamped wave arrangement and a primary and secondary circuit properly tuned and including a microphone, he has been successful in reproducing the singing voice with the galena contact. The phenomenon is attributed to thermal effects.

Copper-Clad Steel Wire is made by casting molten copper about a specially treated round billet, carefully centered in a round mold. The composite billet is subsequently hot rolled to a wire rod, and then cold drawn to copper-clad steel wire. The coextension of the two metals is said to be equal, and the per cent of coating remains the same at all stages of manufacture. Bending, twisting, stretching and breaking the wire only proves that the copper coating is practically homogeneous with the steel core. It is also claimed that the copper-clad wire is 50 per cent stronger than galvanized wire and 60 per cent stronger than solid copper wire of the same section

Northolt Radio Station.—With an aerial system consisting of a triangular network, each side of which will be 650 feet in length, the Northolt station, quite close to London, is now nearing completion The aerial will be supported by three wooden lattice towers, each 446 feet high. The transmitting equipment will consist of Elwell-Poulsen arc generators fitted with remote control. In the near future a valve set employing the high-power Mullard silica valves will also be installed. Although the output to the aerial is 50 amperes or more, this station will be operated directly from the Central Telegraph Office in London, at speeds of about 60 words per minute; but provision has been made for the installation of high-speed signaling at more than 100 words per minute

New York's Wireless Fog Signals.—The Secretary of Commerce has announced that in view of the important development of a radio compass by the Bureau of Standards, three wireless fog signals would be immediately installed at the entrance to New York Harbor through the Lighthouse Service Each of these three stations is equipped with an automatic radio set sending out signals continuously during fog or thick weather. They may be picked up on shipboard by means of the new radio compass which indicates the direction from which the radio signals are sent out, and by taking observations on the different stations the captain of a vessel may determine his exact position without being obliged to rely on the former unsatisfactory method of locating himself by the sound of whistles and fog horns.

Fatal Electric Shock.—In a Vienna workshop an electric freight elevator operator was found dead on his seat, evidently from shock On examination the cause of the accident was traced to defective contact on the electric safety device which prevents the elevator motor operating until the iron elevator door is closed. The seat and its framework are grounded and, therefore, a voltage exists between these and the individual phases of the 220-volt three-phase supply, which, according to the state of insulation of the whole system, often nearly approaches 200 volts The iron elevator doors are not grounded Owing to the defective contact, the iron door in closing became alive, and thus a voltage existed between it and the operator's seat, which was the cause of the man's death. The accident proves the importance of grounding all ironwork used in conjunction with electrical apparatus, irrespective of voltage, particularly where alternating current is employed.

Astronomy

Seeking an Observatory Site.—Prof. Benjamin Boss and Dr. R. E. Wilson have recently made a tour of the southwestern United States, in search of a place offering the best optical conditions for a new station of the Department of Meridian Astronomy of the Carnegie Institution of Washington.

Radial Velocity of the Greater Magellanic Cloud.—According to observations made by R E. Wilson from Cerro San Cristobal, and reported by the Lick Observatory, on 17 bright-line nebulæ in the Greater Magellanic Cloud, the cloud as a whole appears to be moving with high velocity away from our system.

Astronomical Computing.—The British Astronomical Association has organized a Computing Section, under the direction of L J Comrie The function of this section will be to carry out more or less extensive calculations required by the other sections of the association, and also to prepare tables, predictions, etc

Comet Taylor-Skjellerup.—With regard to the published announcements of the discovery of a comet by Skjellerup, at Cape Town, on Dec 11, 1920, it now appears that the new comet was first seen by Clement J Taylor, of Cape Town, on Dec 8, but on account of an error on his part in reading the hour circle of his telescope, the discovery was not verified until after the independent discovery of the comet by Skjellerup Dr Crommelin, who has communicated the foregoing information to the International Bureau of Astronomical Telegrams, proposes that the comet be called Comet Taylor-Skjellerup.

Neptune's Satellite.—The current annual report of the U. S. Naval Observatory records the progress that has been made in an investigation of the orbit of Neptune's satellite, begun by the late Professor Newcomb shortly before his death Forty-six sets of observations, covering the period from 1889 to 1908, are under discussion. Of these 13 were made by photography at three different observatories, and 33 visually by 13 different observers at six different observatories Corrections to the elements have been obtained from 26 of these sets of observations, and the normal equations are ready for solution for 9 other sets

The Total Lunar Eclipse of April 21-22 will be visible throughout the United States The moon is north of the center of the earth's shadow, but nevertheless near enough to it to become completely immersed At 11:57 P M on the 21st the moon first touches the penumbra, but it will not be till well after midnight that the darkening becomes conspicuous At 1:03 A M the edge of the true shadow is reached, and more and more of the moon will be hidden until, at 2:23 it is completely obscured except for the faint reddish light refracted through the earth's atmosphere Totality lasts only 42 minutes, and the moon is entirely clear of the shadow at 4:26 though it does not leave the penumbra until 5:22 The bright star Spica will be within 10 degrees of the eclipsed moon, making a very pretty spectacle for anyone who gets up to see it

Solar Eclipse of Sept. 10, 1923.—Various preliminaries are already under way for the observation of the total solar eclipse of Sept 10, 1923, the path of totality of which extends across Mexico The Mexican government has established a number of temporary meteorological stations along the path for the purpose of collecting data of cloudiness during the first 20 days of September, beginning with 1919 These data, together with a large-scale chart of the region in question, will be published in 1922 and distributed to observatories throughout the world According to Director J Gallo, of the Tacubaya Observatory, the only good place for an eclipse station in Lower California is Ensenada de Todos Santos Tampico is in the path of totality but not near the central line The harbor of Champoton, in the peninsula of Yucatan, is unfavorable climatically, and totality here is very short

Preparing for Solar Eclipses. — The Eclipse Committee of the American Astronomical Society has made a report on the arrangements now under way for observing the solar eclipse of Sept 20, 1922, in Queensland, and that of Sept. 10, 1923, in Mexico A part of the program consists of obtaining meteorological observations along the path of the eclipse in the years preceding its occurrence, not merely at the corresponding season of the year, but also at the hour of the eclipse, so as to take account of the variations of cloudiness with the time of day. When sufficient data for the two eclipses are available, the committee will publish the same for the benefit of intending observers The committee will also suggest lines of work most needed, serve as a clearing-house in arranging for loans of instruments and apparatus, and compile a list of proposed expeditions in connection with the Mexican eclipse.

Engineering

Live and Dead Lumber.—A report issued by the Forest Products Laboratory states that if sound dead trees are sawn into lumber and the weathered or charred outside cut away, such lumber cannot be distinguished by any known tests from that cut from live trees Most of the wood in a live tree is actually dead, and the specification for lumber should therefore be framed to provide for a maximum amount of decay or insect infestation, and the provision of a clause specifying live timber is unnecessary

Hydro-Electric Development in France. — A recent publication on the development of water power in France states that prior to August, 1914, the amount of hydroelectric power developed amounted to 750,000 horsepower out of an available total of 8,000,000 to 9,000,000 horsepower By the middle of 1919 it is stated that France was equipped to develop 1,165,000 horsepower, furnishing an average of approximately 770,000 horsepower At that time more than 500,000 horsepower was being developed, and it is estimated that in 1934 an average of more than 4,000,000 horsepower will be reached

Colorado River Power Project.—Further details concerning the scope of the extensive hydroelectric project of the Southern California Edison Company, whereby it is proposed to develop 2,500,000 horsepower of electrical energy from sites on the Colorado River outside of the National Park, indicate that in the development of water power of the Colorado River the installations must be made in large units and at such intervals as the demand for power will justify additions of from 100,000 to 200,000 horsepower The *Electrical Review* points out that development in small units would involve greater cost per horsepower, resulting in higher charges to consumers

Stone Screenings.—Recent tests conducted in Montreal indicate that appreciable increases in the strength of concrete may be obtained by the judicious use of stone screenings in the aggregate, or by the substitution of finely-crushed stone for ordinary sand Some of the results showed that as much as 22 per cent additional strength was secured by admixing stone screenings to the extent of 5 per cent of the weight of the aggregate in a given mixture, continues the *Times Engineering Supplement*, while in the case of mortar, where ordinary sand had been replaced by crusher sand, increases in strength from 15 per cent up to 79 per cent were observed in test specimens

Substitute Cross Ties.—The task of finding an efficient substitute for timber ties resulted partly from a fear of impending shortage of timber, and the only substitute made and used on a commercial scale is the I-beam section of a leading American steel mill. These ties, we learn from the American Railroad Association, are efficient on non-insulated tracks under heavy and dense traffic, and the line, surface, and gage can be preserved at reasonable expense Corrosion is, however, a serious factor, and insulation is a problem which has yet to be satisfactorily solved Other substitutes such as steel and concrete or steel and wood have been tried, and some of these show promise of success

Delaware River Power Plan. — Announcement of a proposed plan to develop about 500,000 kilowatts in water power on the Delaware River, at a total cost estimated at $200,000,000, appears in a recent issue of *Electrical World* Active work will be commenced as soon as authorization is received from the Federal Water Power Commission The plan calls for the construction of four dams, at or near Belvidere, Bushkill, Shohola and Butler's Rift, with an average head of 80 feet The total power capacity of these four dams is estimated at about 500,000 kilowatts at normal high water In addition, a steam power plant with a capacity of 100,000 kilowatts will be erected somewhere in New Jersey in order to supplement the hydroelectric plant during seasons of low water

Havre Port Undertaking.—A large job is about to be undertaken in connection with the deepening of the outer harbor of the French port of Le Havre The scheme includes erecting and working, on both north and sides of the outer harbor, transshipping berths, wharves, mooring buoys, raised earthworks, roadways, a dock for petroleum, gasoline and other inflammable hydrocarbides, a complete plant comprising both quayside and floating equipment for handling general goods, coal, heavy oils, petroleum, and gasoline, together with goods sheds, tanks and machinery, likewise, rails running along the quays and joining with the State railway It appears very much as though the French were going to make a strong bid for the world's shipping, judging by this and other extensive improvements in French ports

Uncle Sam's Artificial Fish

The Hatchery Work of the United States Forest Service

By S. R. Winters

ADMINISTRATION of 151 National forests, representing an area of 153,933,460 acres, conservation of timberlands and the reforestation of depleted woodlands are among the duties commonly ascribed to the United States Forest Service Rarely would one visualize this Federal Government bureau functioning as operator of fish hatcheries, collecting trout eggs from streams of plenty and distributing them in much frequented mountain waters as a surety that the proverbial fisherman's luck will not prevail. The popular species of trout constitute a valuable resource of these National playgrounds and clearly it is within the province of Uncle Sam to safeguard the supply and aid Nature in replenishing the haunts of the sportsman

Colorado is a favorite trysting place of anglers, where mountain streams and lakes yield unstintedly of their supply of rainbow, native or black spotted and eastern brook or red-speckled trout The opportunities for the beautiful rainbow trout beckon without restraint, earning for this region the justly-bestowed designation of "The Fisherman's Paradise" Yet Nature is impotent to make continuous and positive this phrase which cannot fail to engage the consuming interest of real anglers Unless restocked these mountain waters would have their supply of fish well nigh exhausted within a few seasons Clearly, artificial propagation is to be desired, a need generously responded to by the State Fish and Game Commission of Colorado and the United States Forest Service—17 National forests enveloping the mountainous area of the State A score of hatcheries are maintained, yielding 15,000,000 fry for restocking the waters where the disciples of Izaak Walton never tire of their ancient and pleasurable pursuit

A peculiar quirk in Nature, it would seem, is that from 75 to 90 per cent of the eggs hatch under the fondling care of man whereas but two to four per cent are transformed into fish when left to develop naturally This interesting observation vouchsafed by fish and game experts suggests the opportunity of unfolding the details involved in the novel procedure of transplanting trout from a region of abundance to streams where the supply is constantly being subtracted from by fishermen Trout spawn in moving water wherever feasible, either in a stream or at the inlet of a lake The rainbow trout usually spawn in May, the native trout defer the process resulting in the multiplication of their kind until July while the eastern brook trout, in their tardiness, spawn in October or November Individuals employed in collecting eggs capture the fish in the lakes high in the mountains And here it may be noted that every official of the Forest Service is a deputy game warden and the protection of wild life and fish propagation suggest a special responsibility

Inlets to lakes are invaded for fish in gathering eggs for propagation purposes Veterans of the reel and rod claim that trout thus assembled should remain in the stream of their acclimation until they are "ripe." Frequently, environments and the formations of the lakes preclude this. Consequently, the trout are assembled and concentrated into a so-called "ripening pen" The latter may constitute a section of the creek, arranged into a trap by stretching wire netting above and below a specified point—from 20 to 25 feet apart The fish are retained in these quarters from two to three days, the time allotted for females to ripen and subsequently yield their eggs Spawn work is done in the afternoon.

The fish are removed from the ripening pen with a seine or by use of a dip-net, being transplanted to wash tubs containing water. Then they are conveyed to a stripping bench. Here, working under an awning, an individual isolates one fish at a time from the tub, holds it with the tail removed from his body, and strips the eggs by moving his forefinger down the side of the fish, from head to tail. Only a few brief seconds intervene, the fish having been robbed of its eggs is deposited in the stream where former and natural habits of life may be renewed. Eggs thus obtained from the female fish are caught in an ordinary tin milk pan, subsequently being fertilized with "melt" or "milk" from the male member of the family Obviously, eggs freshly stripped are flabby and are inclined to form a mass Soon, however, the specimens begin to consume water and gradually become isolated into units Once separated, they are drenched in running water and left in a cool place for one hour where they swell and harden

The housewife who carries her hen eggs in a basket by the dozen to the crossroads store may be contributing to a consignment of poultry products destined for a journey across the continent. Similarly, fish eggs are not used at the point of collection The Forest Service distributes 3,000,000 eggs to 150 different streams and lakes in Colorado Millions of additional fry are transplanted by the State, railroads, and private individuals in the waters coursing through the National forests. The eggs are shipped from Trappers and Marvine Lakes to the Glenwood Springs and Buena Vista hatcheries and likewise to Denver for distribution to nearby hatcheries A small hatchery is maintained at Trappers Lake yielding from 600,000 to 700,00 fry

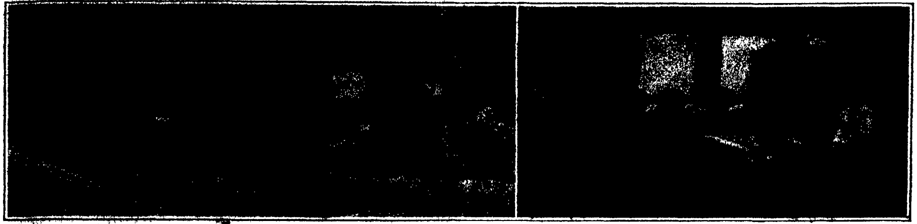
The ingenuity of man which enhances the productive capacity of fish eggs from 4 to 90 per cent likewise devises an efficient method of transporting consignments far removed from the originating point Wooden cases are employed each unit comprising four egg trays and an ice container The egg trays resolve themselves into ten compartments each, 3½ by 3½ inches in dimension. Each compartment has a capacity for 4,000 eggs or 40,000 to the tray—equivalent to 160,000 eggs to the case Wet moss, placed on the bottom of each compartment, gives a downy bed for the products. The moss, gathered from a nearby stream, is reinforced by a strip of damp cheesecloth about ten inches square. The eggs, having hardened, are dipped from the retaining pail with a measuring cup having a capacity for 4,000 eggs. They are poured on to the cheesecloth which is forthwith folded over the eggs, and then covered with another layer of moss. Having filled all the trays they are inserted in a wooden case. A tin tray with holes in the bottom is packed full of ice or snow and is placed on top of the fish-egg trays. The bottom of the compartment trays being a fine mesh the water from the melting snow or ice seeps its way through the moss and cloth, thus penetrating all portions of the container. The eggs are thus surrounded by a cool atmosphere, insuring their soundness until they reach the hatchery. If a considerable distance is to be covered, ice or snow is renewed in the tin container at frequent intervals. A maximum time limit of ten days is fixed for the preservation of the eggs when subjected to these shipping conditions, abrupt jarring being studiously avoided.

Eggs taken at Trappers Lake are packed on horses and conveyed to Marvine, 10 miles distant; thence by automobile to Rifle, 75 miles, and shipped by railway to Denver or other hatcheries—the distance ranging from 75 to 300 miles. Upon being received at the hatchery, the eggs are placed on wire-bottom screens, 12 by 14 inches in dimension. These are soused in troughs of running water, preferably spring water. At a temperature of 50 degrees, the eggs develop eyes in 25 days, and complete the transformation in from 45 to 50 days. If the water is warmer, the time required for hatching is less—approximately, each degree of heat curtailing three days from the hatching period. The young fish, when first hatched, possess a food-sac attached to the under portion of the body. Until this formation is absorbed, after an elapse of 20 days, they reject all food. With the obliteration of this growth, finely-pulverized liver is devoured with relish.

The young fry are shipped from the hatchery for planting in streams and lakes when an inch or more in length. The well-known cannibalistic tendencies of large fish to devour the offspring of the species will not permit of the release of the fry from the retaining pond until they have attained the fingerling stage. Having developed some size, the fry is able to withstand the law of the survival of the fittest as it applies to streams inhabited by fish when existence is perpetuated by devouring their kind. Brook trout are transplanted from cultural conditions to the mountain waters in the spring while rainbow trout change their environment during the fall months. Observations in the propagation of trout in the National forests serve to explode the theory that fish will develop fungus or die if handled. Wet hands will obviate any ill effects that may be threatened by fondling the finny tribe. To illustrate, at Trappers Lake 10,000 fish come in contact with wet hands and no trouble has appeared.

Left Taking fish from the ripening pen, when the females are "stripped" for their eggs. *Center* The equipment used for shipping the eggs. The filled compartment holds 4,000 future trout; the white substance in the pans is snow for refrigerating purposes. *Right:* A close-up of the stripping process, by which 400 to 600 eggs are obtained from each female fish

Where the Federal fish hatcheries get their raw material



Left: Electric yarder and duplex loader mounted on sled. *Right* Induction motor for direct drive of wood saws

Electrically-operated equipment of the logging industry

Logging by Electricity

By Alfred Longville

OVERCOMING seemingly insurmountable obstacles, a logging company operating in the States of Washington and Oregon has demonstrated the value of electricity in felling timber For the first time, perhaps, in the history of the industry electric current has supplanted steam power for exploiting lumber resources of a region. An electric transmission line of 32,150 feet was constructed, penetrating the densely wooded areas of the National forests, and rendering available for market 14,000,000 feet of timber.

Electrifying the woods was a "trail-blazing" feat of difficult attainment A steam donkey or locomotive minus the steam, was the nucleus for initial experiments. Without steam, the first obstacle encountered was the absence of a signal whistle. As a makeshift arrangement, an electric horn was attached, located 50 feet from the electrical equipment, but the din of machinery operation rendered indistinct the clarion call of the whistle in giving signals to the working crew.

Here is how the problem was solved: A 2½ by 3 air compressor was installed, hooked up to a 3-horsepower motor The compressor is piped to a storage tank, 30 by 60 inches, and the pressure is constant at 100 pounds. Driving the air by the operation of the motor, about five minutes each hour, the pressure is sufficient to take care of the whistling

Logging by electricity was begun with a 250 kva transformer, subsequent developments proving the inadequateness of this capacity. Tests, however, have not offered definite recommendations on this point. The transformer, at donkey end of transmission line, is placed three or four hundred feet from the spar tree, obviating interference of yarding and loading

The 18,000-volt transmission is terminated on two poles at 8 foot centers, at the transformer. A disconnect switch is mounted on these poles, making it feasible to cut off the current at this juncture Current from the 550-volt side of the transformer is conveyed to the motor through a 3-conductor armored submarine cable placed along the ground between the transformers and yarder motor

Difficulties of operating the motor slowly enough to be in unison with the requirements of logging and in regulation of drum controller in starting, stopping and controlling speed of the motor had to be surmounted Acting upon the theory that it is essential to add resistance in rotor circuit until the motor speed is lessened sufficiently, the electricians then rearranged the wiring of the drum controller for the accommodation of a wider range of control. Barrels of water were connected with each of the three phases of the rotor circuit until the speed required was ascertained by raising or lowering the barrel of water to the circuit

Imagine the exasperation of the lumberman hauling around barrels of water as excess luggage to an equipment already cumbersome! But the tests of connecting the donkey engine with the water barrel is not a frequent performance Basic information is available from a single experiment: Simply calculate the watts dissipated in each barrel and the carrying capacity necessary to be obtained in some other form of resistor The Washington logging company added a resistance of 3 ohms in each of two phases and a resistance of 6 ohms in the remaining phase of the rotor circuit.

A cost accounting system has been kept to indicate the expenditures as well as the merits of the system of logging by electricity. For building and maintaining the transmission line, calculations have been based on 5 per cent depreciation for the copper and conductor, 20 per cent depreciation for cross arms and insulators and 100 per cent for labor and incidentals A half a day is required for four men to establish the transformer every time the yarder is moved to a new setting The yarder has been in operation for 234 consecutive days without interruption for repairs

Comparative costs of logging with electricity and steam, as evidenced by the records of this Western lumber company, produce the following fact Electrically-driven yarder logs for 52 cents per thousand less—saving $7,280 in 210 days on a yarder alone Supplement the cost of maintaining motor and controller, and the total cost is only 11 cents per thousand feet of timber It requires 2.8 kilowatt hours energy input to log 1,000 feet

Aside from the possibilities of developing power sufficient to do logging in heavy timber, at a reasonable outlay of expenditures, the United States Forest Service considers the introduction of electrical equipment as an added precaution in minimizing the annual toll of $40,000,000 exacted by forest fires Logging equipment and camps are the sources of unnumbered forest conflagrations.

The electric yarder and duplex loader in operation form the subject of our present colored cover

The Civil War Carved in Granite

By James Anderson

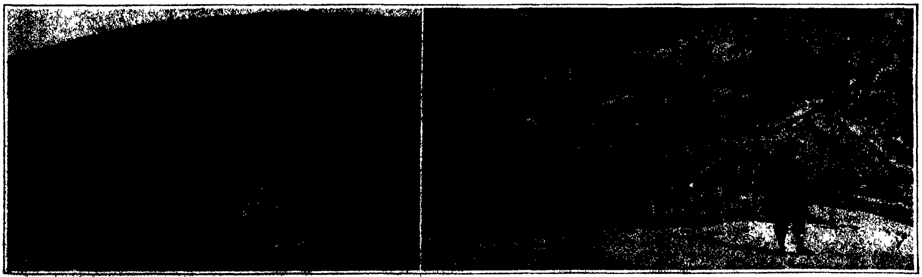
STONE MOUNTAIN, a solid granite monolith rising sheer out of the landscape about twelve miles east of Atlanta, Georgia, will begin this spring to assume the aspect of a granite memorial to the Civil War "The Lost Cause," a gigantic sculptural representation of an army of one thousand Confederate leaders, is to be carved in the face of the mountain, which is fifteen hundred feet long and one thousand feet high After eight years of planning, the engineering framework for this stupendous monument is being laid, so that in the spring work on the army may be started Gutzon Borglum, the eminent American sculptor who originated the idea of this vast memorial is to superintend its execution

Plans had been completed in 1917 for beginning the work when America entered the World War The mountain had been surveyed, and a road cut to the top. Even hoist cables and some machinery had been installed Nothing further was done, however, until January of this year, when complete support was pledged for the renewal and completion of the undertaking after the unavoidable interruption

The huge nature of the conception staggers the imagination Big as the mountain is, it is absolutely without seam, crevice, or fissure The monolith's southern, eastern and western exposures are oval in shape, so that the vast natural canvas is like a tea-cup cut in two No other stone in the world, so far as known, affords so wonderful an opportunity for the sculptor Mr Gutzon Borglum says the quality is perfect, as the gray granite of the northern side, where the army will take shape, is protected from the sun and is not affected by the weather There is never sufficient frost to react on the stone The southern exposure is influenced slightly by the action of the sun but the moisture of the dew creates a slight expansion so that altogether conditions are ideal for a permanent memorial

The sculptural aspects of the work presented a task which might have made an artist less experienced than Mr Borglum shrink from beginning it The plans have, however, been completed The army is to be composed, as said, of one thousand complete figures Each figure will represent some leader in the Army of the South, but more than that—each will be a portrait capable of

(*Continued on page 297*)



Left: The northern exposure of Stone Mountain, on which the Borglum sculptural representation of the "Lost Cause" will appear. *Right:* View of the countryside from the top of Stone Mountain

The natural canvas on which the Civil War is to be painted in granite

Left: Redwood tree, showing its size as compared to the man, who can be seen on sufficiently careful search of the picture. *Center:* Seventy-five large thickening tanks of redwood in a big copper refinery at Anaconda, Mont. *Right:* A wooden stave pipe line of redwood, installed by the United States Reclamation Service in Montana

The redwood tree, and some of the uses found for its wood

Some Special Uses of Redwood

The Pride of California's Forests and Some of the Roles That It Plays

By Arthur L. Dahl

THE California redwood has become famous throughout the world for the age and size of its trees, for outside of the *Sequoia gigantea*, or "Big Tree," the redwood is the oldest living tree, some of them being over 3,000 years old The trees, in their majesty and grandeur, are well worth preserving in limited groves, to be used as national monuments or playgrounds for the people, but there are thousands of acres of virgin redwood forests in California that are available for the commercial needs of the people

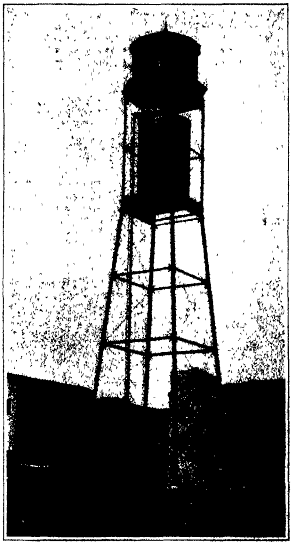
The very qualities that have enabled the redwoods to defy time and live on through the centuries, make the lumber from the fallen monarchs especially valuable for certain specific uses While redwood is used for all kinds of construction and finishing purposes in the districts contiguous to where the lumber is manufactured, a larger market has been created for this species for use in the manufacture of tank and pipe staves, paving blocks, shingles, ties, and many other articles The heartwood varies in color from a light cherry to a dark mahogany, and the wood is generally straight-grained and is comparatively light and soft Redwood is more highly resistant to fire and the attacks of insects than any other species, and these qualities have caused a great many manufacturers to use the wood in the construction of silos, water tanks, roofs, fire walls, and other things where it is desired to guard against fire or the attacks of insects

Redwood is peculiarly immune from either dry or wet rot, for cabins built of redwood in California more than 110 years ago are still in use at Fort Ross, and although these cabins are in exposed places in the fog belt, where for many months in the wet season they are exposed to heavy rains and the cold wet fogs that sweep in from the Pacific, they show not the slightest rot or decay. Redwood fence posts, dug up after 75 to 100 years of service, show no signs of decay There are instances of giant redwood trees having been struck by lightning and broken down, and lying for centuries without having the wood affected in any way One such case is of a tree trunk that lay on the ground for 900 years, and yet, when the area was logged over, this trunk was made into lumber

It is a universal practice to use redwood door and window frames in California, and even though buildings are constructed of other kinds of wood, redwood is always used for that portion that comes in contact with the weather, as well as that part covered when the frame is set into the building and which is likely to be reached by moisture or rain seeping through the casing

Redwood not only defies decay, but resists the destructive action of acids and alkalis, and it is commonly used in the manufacture of tanks containing chemicals The big copper companies use redwood leaching tanks that contain corrosive acids for the refining of copper At tanning works, redwood tanks that have been in constant use for 55 years are still good for as many years more, and the California Wine Association has used the same redwood tanks for over 25 years and they are as good as new today.

Redwood is successfully used as insulating material, and one silo manufacturer states that two inches of redwood is equal to 3 inches of concrete in insulating power. In a large plant for the making of ice, redwood was used throughout, and although this plant has been in operation over 15 years nearly all of the redwood boxes encasing the brine piping are still in use In spite of the fact that the temperature of the inside of these insulation boxes is 6 degrees above zero, and the temperature in the engine room of the plant is 80 degrees, there is no shrink, warp, swell, twist or check in these boxes, nor is there any gathering of frost on the outside of the boxes, which would indicate free conductivity through the wood.



Two 30,000-gallon tanks of redwood on a single stand in California

Redwood is largely used in the manufacture of coffins and burial boxes. The natural fineness of the grain works up well, and the surface can be stained to any desired effect. Its natural decay-resisting qualities enable coffins made of redwood to last longer underground, and the United States Government has found that redwood coffins are best suited for use in the tropics because it affords the highest type of protection to the body. It is very resistant to the termite or white ant of the tropics

Redwood enters largely into the manufacture of brooders and incubators used in the poultry industry An incubator, because of the difference in temperature between the interior and exterior, requires a wood that holds a tight joint, is unaffected by differences in temperature, or alternating wet and dry atmospheric conditions.

For the manufacture of cigar boxes, candy boxes and other light containers, redwood is coming more and more into vogue. The wood is light, does not warp, makes tight joints and has a pleasing appearance A number of candy shops on the Pacific Coast feature redwood box containers for their goods, and orders come from all parts of the country for the candy packed in the boxes which can be used permanently for other purposes. One shirt waist maker of the East uses large quantities of light redwood boxes which are utilized in making shipments to tropical countries.

Redwood is used in the manufacture of organ pipes because it does not vary in the slightest degree through change in temperature or atmospheric conditions, and its freedom from pitch and gum enables its use for the finer parts coming in contact with the felts and leather valves of an organ.

Because of its light weight and resistance to rot, California redwood was used for the clock hands on the tower of the Custom House at Boston. The minute hand is 16 feet long, and weighs 141 pounds, and the hour hand is 12 feet long and weighs 112 pounds.

Redwood is quite generally used for floor coverings and redwood blocks are excellent for street paving; and there are many examples of the satisfactory wearing qualities of the wood when used for these purposes.

The original machine shops of the Union Iron Works at San Francisco were floored with redwood blocks in 1896, and they are still giving good service. In fact, when the Bethlehem Shipbuilding Company built its new plant in Alameda, the flooring was all made of redwood blocks, and the United States Government used the same material in flooring the machine shops at

(*Continued on page 297*)

Rails and Railroads

Some Facts and Figures of the Annual Traffic in New and Old Steel Rails

By Robert G. Skerrett

MUCH has been written about the mechanics and the metallurgy of steel rails such as we have on our various trunk lines. The public in a measure is conversant with what has been done toward producing heavier and better rails designed to support greater loads and to stand up under the hammer blows and the cold-rolling action of rushing wheels. But comparatively few of the shippers of freight and the traveling populace know what happens to the rails during their life history and what is done with them when they are no longer deemed fit for main-line service.

The story of the steel rail from the time it is first laid until it is totally transformed in its conversion to other uses is one of economics and conservation that is well worth the telling. It shows how keen and careful the best of our roads are to save their pennies and it reveals that the dealer in secondary metals has found many ways in which the steel may be worked up before it reaches a stage known to the trade as scrap

We have today a total railway mileage of something like 350,000 miles of single track of all kinds on our trunk lines; and the wear and tear upon this transportational network requires annually, on an average, rail replacements totaling quite 1,500,000 tons If, for the sake of comparison, we assume these rails to be of the 90-pound type, then our mills have to turn out each year for renewals alone enough rails to build a single-track railroad more than 10,600 miles long—three and one-third times the span across the continent It follows that the rails removed furnish material which can be used for many purposes just as it stands, or the basic metal can be converted into numerous shapes for which there is an ever increasing market.

Indeed, our busy trunk lines would have to lay each twelvemonth a much larger tonnage of new rails but for the efforts made by them to keep every rail in the track as long as it is safe to do so. This is one of the savings effected by the alert guardians of the maintenance of way, and it marks the difference between the practices adopted by efficiently administered lines and those that are less watchful of the leaks that add to operating costs. Most of us imagine that a rail once laid remains in that fixed position until worn to a state where it must be scrapped, but such is not the case The average life of the run of heavy steel rails is probably about 25 years; and this covers their successive applications to different traffic needs before they are condemned by the roads and sold to the dealers in waste materials Now let us take up this sequence of usefulness in a necessarily brief way

EACH twelvemonth our steam trunk lines replace their worn tracks with 1,500,000 tons of new rails That is to say, they discard enough old rails to build a single-track road 10,600 miles long; and if those rails were rolled into a continuous rod an inch in diameter there would be enough of it to wind around the equator 9½ times. As might be expected, this immense quantity of scrap metal is not allowed to go to waste, and before it ultimately reaches the furnace for remelting it is worked into manifold forms and put to scores of services. The purpose of the present article is to tell the life story of the rail from the time it is laid in the main-line tracks of a busy trunk line until it has ceased entirely to resemble the steel ribbon upon which the rushing express train threads its way —THE EDITOR.

Broadly stated, a new rail is originally laid in the main-line tracks for high speed passenger service where it is subjected to the severest stresses, next, it may take its place in the tracks of a subsidiary road where it can meet the less exacting demands of lighter traffic, or it may go to the freight track where, again, it will be found equal to the more ponderous but slower-moving trains; then, having done its bit in either of these departments, it may be put in running sidings, yard tracks, or industrial spurs But what is it that determines when a rail must be shifted from its first position of high estate, so to speak? And what is done to make it stay there as long as possible?

In a general way, most of us are aware that trains are guided along the tracks by the projecting flanges on the inner edge of the rims of the great driving wheels and the lesser car wheels, and we know that the rims transmit the load. Therefore the bearing surface and the inside portion of the rail heads get most of the wear. In practice, however, the two neighboring rails in any section of track are seldom subjected to the same destructive forces, and their heads are usually deformed and ground away in differing degrees and at dissimilar points. The railway man's problem of maintenance of way would be a comparatively simple one if nature permitted him to lay his tracks in a straight line and upon a level plane. Even the easiest of turns or swings in the course of the line introduce difficulties; and these are intensified when the terrain imposes many curves. For example, in the run of 150 miles between New York and Albany 65 per cent of the route is curved, and over this stretch of road are rushed some of the very fastest of our heavy passenger trains.

On a curve, the ties are sloped so that the outer rail is higher than the inside one. This is done to check the tendency of a train to go straight on instead of swinging in the desired direction. The movement of a train on a curve, therefore, throws a heavier share of the load on the low rail and subjects the high rail to a greater side pressure. As a consequence, the high rail is ground away on the inner side of the head while most of the wear on the low rail comes on its top The change of shape of the high rail widens the gage or interval between the tracks, permits the wheels to shift laterally more than they should, and, because of this, the lower wheels move toward the inside of the low rail and deform it radically, if this action be not arrested. And here it is we come to the means taken by the men of the maintenance of way division to neutralize the wear and to keep the rails in service

Just once so often the gage of the road and the state of the rails is measured by an apparatus called a rail-section machine, and this device traces the contours of the rail heads and reveals precisely how and to what extent they are being worn or altered With this data, it is practicable to tilt or to so reset a rail that the wear will be lessened or shifted to another part of the head. Again, the trackmen, by moving the rails closer together, can restore the proper gage and minimize the lateral play of the wheels which is apt to be rapidly injurious if not kept within certain bounds Further, a somewhat worn high rail may still be good enough to serve as a lower rail, and this transposition is a common practice.

A rail in a straight stretch may have its head worn down uniformly but be otherwise sound and, superficially, may appear fit to remain in the line This loss of metal, however, has robbed it of its "snap"—its capacity to react and to develop the desired springiness when subjected to the load of a passing train Therefore, a rail of this sort that cannot meet the requirements of high-speed passenger traffic may answer very well for less exacting work By watching and then nursing the rails into advantageous wearing positions, while maintaining the gage, the rails can be made to give a longer useful life. Not only that, but this care will render it practicable to employ a lighter and probably a cheaper rail

On grades, as might be expected, even though the line is straight, the wear is heavy because of the abrasive action of the driving wheels when a train is climbing the slope. This grinding is intensified if the weight of the train or the condition of the track requires the use of sand. Again, the tracks in tunnels, either curved or straight, suffer deterioration at a fairly rapid rate owing to the presence of corrosive gases and dampness. It is interesting to note, however, that improvements in metallurgical practice are doing much to lengthen the useful life of rails

In 1915 one of the most progressive of the eastern trunk lines substituted manganese rails for regular open-hearth rails, and laid these in an especially busy section where the high-grade, open-hearth rails had lasted only eighteen months, supporting the while 56,560,000 tons of traffic. The manganese rails up to date have withstood the wear and tear of 290,900,000 tons and will endure for a number of years to come. Any stretch of road carrying 50,000,000 tons in the course of a twelvemonth is exceptionally active; and this particular division has averaged for some time past quite 44,000,000 tons annually.

And now let us see what becomes of the 1,500,000 tons of rails that are scrapped every year A goodly percentage of these second-hand rails are purchased by dealers in such materials and sold to industries that need spurs feeding to and from the main-line tracks. The unaltered rails are put to use by lumbermen in log-rolling outfits, and they serve admirably for the tramways of brick yards, sand pits, stone quarries, etc. Where large engineering undertakings are in hand, the rails are laid to support mechanical equipment, such as cranes, steam shovels, etc , and they provide the necessary lines of travel for spoils trains and for cars delivering structural materials Light rails, as a rule, are well suited to work of this kind

There is generally enough material left in the heads of the worn rails from our principal trunk lines to permit the rails to be rerolled and thus fashioned into sound ones of lesser weight For example, an 80-pound rail can be reduced to a 30-pound or a 25-pound rail of greater length, and some experts claim that the rail is all the better for rerolling The authorities, however, are not in accord upon this point The light rails of rerolled stock are extensively employed in mines, on rice and sugar plantations, in strengthening the foundations of tall chimneys, in stiffening the support for pumps at the stations of pipe lines, and as buck-stays for vaults under side walks, etc Indeed, old and even new rails constitute part of the defense of a good many safe deposit strong rooms

Rails that have been so damaged in service that they cannot be rerolled into other rails or are quite unfit for transportational purposes in any direction, can be fashioned into a wide variety of marketable commodities This is possible because of the excellent character of the basic stock There are a number of rolling mills in this country which depend mainly upon old rails for their raw material, and it is astonishing how many things they are able to make from them In some of these plants it is the practice to split the rails lengthwise into three parts, thus separating the head, the web, and the base, all of which are next cut into 4-foot lengths before heating and running them through the forming rolls. From the heads are produced round, square, and hexagonal bars, from the web is turned out flat steel for tires, etc , or U-shaped channels, and from the base or flange are obtained various small angle bars From the web and base together it is feasible to roll tees and diamonds, U-bars, and the like, which are especially suited to numerous applications One of the biggest fields for bars made from old rail heads is that of reinforcing concrete in its well-nigh limitless adaptations, and the demand under normal conditions is in excess of the supply

It may interest the average citizen to know something more about the way these manifold steel commodities fit into every-day life The makers of agricultural equipment and machinery might be hard put to it for parts if it were not for the shapes, angles, and steel flats that have their origin in discarded rails The frame, the bracing, and many other features of mowers, cultivators, harvesters, harrows, rakes, plows, etc , are formed of these materials, which insure both lightness and sturdiness This department of industry absorbs yearly an immense quantity of the stock in question

The next time you turn into your metal bed or throw yourself down for a moment's rest upon a couch, just remember that you may be reclining upon the by-product of a railroad track. In all likelihood the bed or couch frame, if not the frame for the springs, is composed of the angle bars already mentioned The folding or collapsing beds so frequently tucked away in modern apartment houses are built up generously from steel of this character In truth, much school and office furniture, many show cases, shop fixtures and kindred appointments have embodied in them these strong and light metal parts. It calls for no stretch of the imagination to grasp that the makers of automobiles, trucks, carriages and sleighs get certain of their fittings from the mills that rework second-hand rails

As a matter of fact, if a person look about a bit, he'll find steel of the nature referred to doing service

(*Continued on page 297*)

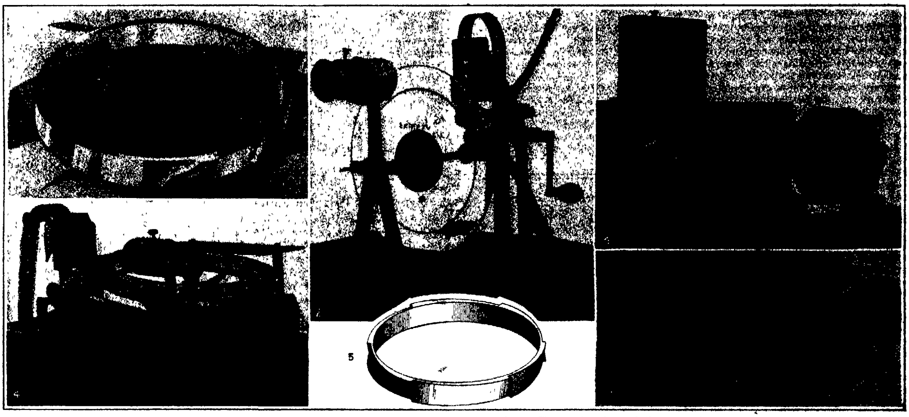
Two Hundred Thousand Photographs per Minute

Eliminating the Shutter and Intricate Intermittent Movement to Speed Up Motion Pictures

By C. H. Claudy

COMPLETE visual analysis of complex and rapid motion has not, up to date, been possible except in rare instances. We see a horse gallop, a propeller revolve, a gun carriage recoil, but just *how* the horse's foot and leg move, just *how* the propeller bends under the stress of its revolution, just *what* happens to a gun carriage under the shock of recoil, we do not know.

Motion picture apparatus of the variety known as the "speed camera" solves but a part of the problem. Some cameras are made to take one hundred pictures per second—6,000 per minute. If such pictures be projected at the normal rate of 1,000 pictures per minute, the action on the screen takes place in six seconds, which took place in life in one second. The motion is thus shown six times slower. Most readers are familiar with those beautiful "floating" men, horses, dogs, cats, in pictures, which run, gallop, climb, very, very slowly. But six times slower than normal is not slow enough for projectiles, gun carriages, propellers and a dozen other rapidly moving objects of which motion analysis is urgently needed.



1.—One of the Jenkins ring prisms of the simpler design, showing how the reversing prism effect is obtained. 2.—The simplest form of the new prismatic projector, consisting of a standard sprocket for moving the film continuously, a revolving plate prism, a lens, and a source of light which is not shown in this skeleton model. It will be noted that the elaborate framing device and intermittent movement mechanism of the usual motion picture projector are eliminated in this novel departure from standard practice. 3.—The high-speed Jenkins camera which, like the projector, makes use of a revolving prism instead of the usual revolving shutter and intermittent movement mechanism. This camera must be driven by electric motor in order to obtain a high and uniform speed. 4.—Another form of Jenkins prismatic projector reduced to its essentials. In this case the ring type of prism is employed. However, the ring prism is said to produce pictures less perfect than the plate form, although the optical principle is the same. It will be noted that the ring is inclined, so that the rays of light will only pass through the ring at one point. 5.—Diagram of the multiple prism ring used for the ultra-rapid camera. Six prisms are included in this ring. 6.—One of the Jenkins plate prisms

High speed motion picture projectors and camera which make use of prisms instead of the usual shutter and intermittent movement mechanism

Hence, when C. Francis Jenkins, of Washington, D. C., originator of the intermittent motion which is the foundation-stone on which all motion picture apparatus is erected, announces a "continuous motion picture camera and projector," and declares he believes it entirely possible to make 200,000 pictures per minute which will slow up normal speed motion *two hundred times*, or make motion requiring one second in life extend over two hundred seconds of time in the picture of it, the scientific world is apt to take keen notice.

The Army and the Navy have already taken notice. Both arms of the Government have purchased these high speed cameras, after witnessing some examples of "slowed motion" made with them, and are keenly interested in the motion analysis which are to come from these instruments.

It must not be imagined that a continuous motion picture camera and projector is only of use in making motion analysis. Intermittent motions wear out. They tear the film. And they use twice as much light for the given result as the continuous motion, because they are provided with shutters, closed half the time, whereas the new projector (and the new camera) have no shutters, and use the lens to within a tiny fraction of its full value (about 99.5 per cent instead of the present day 33⅓ to 50 per cent.

Continuous motion picture projectors have been invented before. But they were either prohibitively expensive, inefficient, delicate, used other than standard film, or were otherwise impractical and uncommercial. The Jenkins machine is far simpler than the normal intermittent motion machine, less expensive to make and maintain, has fewer moving parts, uses standard film and standard lens and requires just half as much current for lighting as the ordinary machine.

It is an extraordinary sight to watch a band of motion picture film running continuously from one reel to the other, with no stop, start, click, jerk or noise, and nothing but a smudge in the picture aperture, and then turn the eyes to the screen and see the usual moving picture. It is still more extraordinary when the simple means employed are understood. For the only additions to the ordinary projecting mechanism are revolving plates of glass, while the subtractions from the machine are all the usual framing, shutter and film moving mechanism.

The theory of the Jenkins continuous motion picture camera and projector is simple. If it were possible to *hinge* the light rays after they pass through the lens in the camera so that they impinged on the film in one position and remained upon the film in that position as the film moved downward, the light rays would act upon the film in the same manner as unhinged rays would act upon a stationary film.

Such a hinge might be made of a long bar of glass, say thirteen inches long, which at one end was a prism with seven-degree sides, its base above, its apex below, and which constantly changed its angles until at the center the "prism" was no longer a prism but a bar of glass with straight parallel sides, and then at the farther end was again a prism with its apex above, its base below. If such a reversing prism were slid lengthwise through the light coming from a lens, and the time it took in its travel was exactly the time required for one frame to pass through the picture aperture, that film would receive a complete picture without blur, exactly as if it stood stationary and no prism were interposed. But a moving picture mechanism which pushed thirty inches of glass prism from left to right and then jerked it back again to start another movement, would have an intermittent mechanism far more complicated and difficult than the present.

All of this Mr. Jenkins knew. What he did not know, however, was that he could bend the straight glass prism in a circle, join its two ends, and revolve it through the light cone.

The problem had to be solved from the very beginning. A prism which reversed itself through its length was bad enough, but one which was circular into the bargain required an entirely new grinding machine. Before Mr. Jenkins could grind the ring prism he had to invent the grinding machine which would make it. This he did, and with the intensely interested assistance of the authorities at the Bureau of Standards, the machine was put to work.

Grinding his reversed prism on the edge of a sheet of glass for convenience, he now has a projector equipped with two such ring prisms, operating with overlapping edges. Parenthetically, there would seem to be no mechanical or optical reason why both sides of this prism should not be ground on one pane of glass, reducing the moving parts. Mr. Jenkins has made and put into use ring prisms with six and eight completely reversing prisms in a single circumference which allows six and eight pictures per single revolution of the glass, thus requiring, for fifty thousand pictures per minute, but eight or nine thousand r.p.m. of the glass plate. Inasmuch as there is no reason why the glass circle may not have more prisms and be enclosed in a ring of steel, to take the centrifugal pull, there is no reason to suppose a limit of speed in making pictures which shall be caused by the strength of the materials employed.

Indeed, the limits have been set ahead away beyond that of mechanics. There is now no question, "Will the film tear?" as happens when much more than one hundred pictures per second are attempted with an intermittent motion. There is now no question, "Will the mechanism stand it?" The question is, "How

(Continued on page 297)

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Left: Looking forward in the passenger cabin of the Caproni seaplane. There are accommodations for 100 passengers *Center.* General view of the giant seaplane on the ways. Note the rear set of planes which carries the vertical planes that act as rudders. *Right:* Controls of the giant machine, arranged in duplicate. The central panel carries the various push buttons and switches controlling the various parts and engines of the machine

Three views of the giant Caproni seaplane recently completed in Italy

The Giant Caproni Seaplane

FOR over a year past there have been persistent rumors of a giant airplane being constructed by the Italian aircraft constructor, Caproni. This airplane was talked of in connection with a transatlantic flight, but later it was reported to have a carrying capacity of 10 passengers and to be intended for passenger-carrying purposes. At last the photographs and data regarding this Italian achievement have come out of Italy, although it is unfortunate that these should reach us only after the machine has been wrecked in the preliminary trials.

The Caproni machine proves to be a seaplane of radically—indeed, one might well say daring—design It has three sets of triplanes arranged in tandem and mounted above a long boat body. There are eight motors of the Liberty type, aggregating 3,200 horsepower. The machine weighs 30,800 pounds empty, and can carry a useful load of 22,000 pounds. This useful load factor, when translated in terms of commercial utility, means carrying one hundred passengers with sufficient fuel supply for a flight of five to six hours. Beyond a doubt, this is the largest heavier-than-air machine so far constructed.

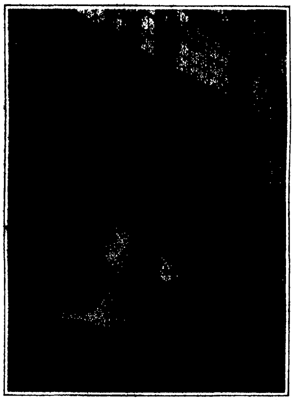
The boat-like body, which has accommodations for one hundred passengers, measures 66 feet long. The wings have a total carrying surface of 7,150 square feet. The arrangement of the three sets of triplanes is said to give this giant machine remarkable stability in the air, and permits of dispensing with the usual tail construction Each wing carries an aileron, and it is the manipulation of these ailerons that controls the ascent or descent of the machine The steering is controlled by eight rudders which are mounted between the wings of the rear triplane Great stress is laid on the automatic stability of this machine, which is gained by the triplane and tandem arrangement, and the facility with which it can be piloted. And then it follows, too, that with the great weight and horsepower back of this machine it is not apt to be disturbed by the very winds that hamper the smaller airplanes. The Caproni giant, in flying trim, represents 25 tons.

The wings measure 132 feet in span. The motors are distributed as follows· Four in the front body, driving three tractor screws, and four in the rear body, driving three propeller screws. The speed is about 90 miles an hour when the engines are operating at full power.

Reducing the Electrode Costs of Electric Furnaces

IN operating electric furnaces for making steel, a source of a great deal of trouble and loss of heat is the action of the hot gases in the carbon electrodes themselves where they enter the roof. Here they are usually eaten away with consequent loss of heat and electrodes.

A Philadelphia electrical engineer has developed what he terms an electrode economizer. It is stated that the loss from the amount of heat in the shape of flame that escapes from most furnace roofs is nearly 30 per cent. It was early realized by the inventor that if the flame could be prevented from blazing out at the top around the electrodes, one of the chief causes of losses would be overcome. The invention is patented and can be used on all types of electric furnaces



A three-ton electric steel furnace equipped with electrode economizers

The economizer depends for its action on the scientific principle that hot gases under pressure, if suddenly allowed to expand, quickly lose their high temperature The gases generated in an electric furnace are only combustible at high temperature and in the presence of oxygen. All other cooling rings simply content themselves with cooling these burning gases. In the economizer the gases never ignite, the roof ports and the electrodes are kept reasonably cool and the gases leaving the furnace are at too low a temperature to ignite

The gases pass first of all between the electrode and the port-hole roof, and then through a small clearance into the cooling ring and into a relatively larger chamber which causes the expansion of the gases, thereby receiving a large amount of sensible heat This heat is absorbed by the water in the cooling ring From this chamber the gases are once more contracted through a small clearance and then passed to a very large chamber for a second and chief expansion. The design differs slightly with amorphous or graphite carbon electrodes, but the effect is that no flame is seen from the top of the furnace and the electrodes do not pencil off

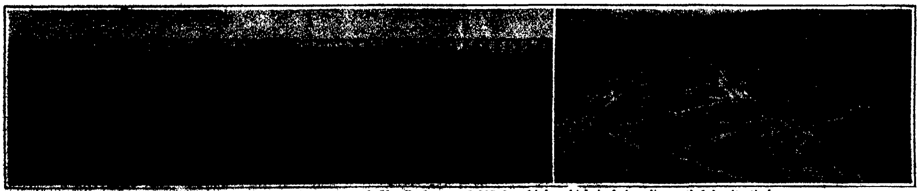
The illustration is of a 3 ton Greaves Etchells furnace at Tacony, Pa, equipped with the economizer It shows the actual size of the cooling ring and it will be noticed that, although the electrodes are withdrawn and the furnace is pouring, there is no flame or reduction of diameter Even when carbon is thrown on the slag, no flame appears On a recently installed 4 electrode furnace, the monthly figures were 12½ pounds of graphite electrodes per ton The average over six months was 13 pounds

Recovering Fuel from Ashes by Magnetism

AFTER several years of experimentation the well-known German firm of Krupps has succeeded in perfecting a process through which large percentages of fuel can be recovered by means of magnetism from cinders According to *La Revue Général de l'Ectricité* quoted in *La Nature* (Paris), for December 25, 1920, this process makes use of the magnetic property which resides in the cinders (scoriæ) because of the compounds of iron which they contain It is stated that it is possible to recover in this manner in the form of coke no less than 25 per cent of the weight of the cinders. Since there is an annual consumption of about 100,000,000 tons of coal in Germany yielding 20,000,000 tons of cinders, the general application of the process would secure the recovery of the very considerable amount of 5,000,000 tons of fuel.

Salvaging the Timber in a Giant Trestle

AT Pincher Creek, in the Canadian province of Alberta, three of the world's largest wooden bridges or trestles are being torn down for the timber which they contain The one shown in the two accompanying illustrations is the largest of the three, being over one-half mile in length, and 235 feet high It is said to contain over 1,200,000 feet of timber, which is being reclaimed for shipment to France for reconstruction purposes. The trestles formed part of an abandoned coal mine railroad



Two views of a wooden trestle, over one-half mile long and 235 feet high, which is being dismantled for its timber

Length, 860 feet. *Beam* over bulges, 104 feet *Draft*, 28½ feet. *Displacement*, 41,200 tons. *Speed*, 31 knots. *Armor*: Belt, 12 inches; barbette, 12 inches; turrets, 15 inches; decks, 1, 2 and 3 inches. *Guns*, eight 15-inch, twelve 5 5-inch. *Torpedo tubes*, 6

The latest British battle-cruiser, "Hood"

The British Fleet of Today

A Detailed Account of the Drastic Reductions in the Strength of the British Navy

By Hector C. Bywater

MR. BYWATER, who is one of the leading naval writers of Great Britain, wrote this article at our request, with the object of placing before American readers an accurate and detailed account of the great reduction which has been made in the British Fleet since the Armistice, and a statement of the actual strength of the existing fleet which is now in commission and in reserve. Since this article was prepared, the First Lord of the British Admiralty has announced that a further reduction has been made in the strength both of the whole fleet and of that part of it which is in full commission.

The number of battleships and battle-cruisers in full commission has been reduced from twenty to sixteen as compared with a total of thirty-eight in 1914. One of the destroyer flotillas of the Atlantic fleet has been placed in reserve; the North American and South African squadrons have been reduced by one light cruiser each; and the South American squadron has been withdrawn. Also, eight battleships armed with 12-inch guns, which were held in reserve, have been transferred to the list for sale.—THE EDITOR.

JUDGING from recent discussions both in Congress and the American press there appears to be some misapprehension as to the present strength of the British Navy It will therefore be opportune to give a brief review of British naval policy during the past two years The armistice intervened at a moment when the national capacity for producing naval tonnage was at its zenith Practically every yard in the United Kingdom was at work on Admiralty contracts, including many establishments which had not previously built fighting ships. Twenty-four hours after the armistice had been signed orders were issued for the canceling of every naval contract which had not reached a certain degree of completion At that date the only capital ships under construction were four battle-cruisers, viz "Hood," "Anson," "Howe," and "Rodney" As the first-named had been launched it was decided to complete her, but the remaining three were scrapped, and with them went a considerable number of light cruisers, scores of destroyers and submarines, and hundreds of patrol vessels, auxiliaries, and minor craft Those that survived this drastic "comb-out' were vessels on which so much money had already been spent that it would have been false economy to dismantle them, but they are completing at such a leisurely rate that one of them, the cruiser "Effingham," which was laid down at Portsmouth as long ago as 1917, has not yet been launched. On March 1, 1921, the British naval construction program stood as follows Battleships or battle-cruisers building or projected, none, light cruisers building or completing, 8, destroyers, 7, submarines, 4 The only other vessel in hand is the aircraft carrier "Hermes." The fact that no capital ships of any description are now building is unprecedented in British naval history for the past two centuries, as a matter of fact, *the historians say that to find a parallel to the present stagnation in British dockyards it would be necessary to go back at least as far as the seventeenth century*

Simultaneously with the cancellation of uncompleted ships, steps were taken to cut down the naval establishment by selling off all redundant material and reducing the commissioned fleets to a minimum, a dual process which has been going on steadily since November, 1918, and still continues. Vessels scrapped to date include 4 dreadnaught battleships, 2 battle-cruisers, 20 light cruisers, 200 destroyers, 80 submarines, to say nothing of the whole fleet of predreadnaught battleships and armored cruisers which have been stricken off the navy list and sold to the shipbreakers. In the opinion of many authorities this process has been carried too far. Light cruisers completed as recently as 1916 have been disposed of, together with destroyers and submarines less than three years old It is not denied that a large majority of the doomed ships would have been capable of many more years of active service, but the economists were inexorable, and scores of really fine vessels have been sold as junk.

By April, 1919, the Admiralty had worked out a scheme of post-war fleet distribution which, in their judgment, was the minimum necessary to safeguard British interests at home and abroad and to render possible the carrying on of progressive tactical and sea training. Their proposals embraced the maintenance, in full commission, of an Atlantic Fleet, consisting of ten battleships ("Queen Elizabeth" and "Royal Sovereign" classes), four battle-cruisers, one light cruiser squadron, three destroyer flotillas, and four submarine flotillas, together with a Home Fleet, manned on the nucleus crew system, of six battleships, one light cruiser squadron, and two destroyer flotillas. In addition a "Flying Squadron" of aircraft carriers was to be attached to the Atlantic Fleet. For the Mediterranean a fleet of six battleships, six light cruisers, and a destroyer and submarine flotilla was proposed, while to the other for-

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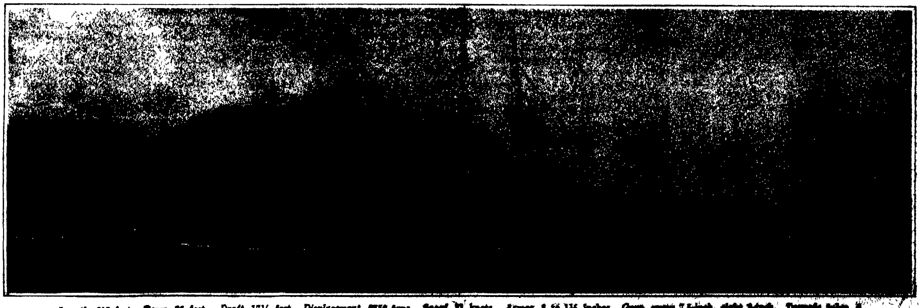


Length, 605 feet. *Beam*, 65 feet. *Draft*, 17¼ feet. *Displacement*, 9750 tons. *Speed*, 31 knots. *Armor*, 1 to 1½ inches. *Guns*, seven 7.5-inch, eight 3-inch. *Torpedo tubes*, 6

The latest light cruiser, "Raleigh"

Bending Ship Plates

SOME of the machinery necessary to construct the large steel ships of today is massive and striking. Its achievements are also equally interesting. The illustration is that of a large ship plate bending roll, used by shipbuilders to bring to the proper size and shape some of the heavy sections of steel plate which go to make up the hull or some important part of a modern transatlantic liner or merchant vessel. This machine is used to scarf simultaneously both corners of a very long and unusually thick steel plate It will thus handle plate 7 feet wide and an inch thick and easily fastens it to the end desired. It is manufactured by a large Delaware company.

Potability of Salt Water

REMARKABLE instances of the extent to which men and animals can become habituated to the drinking of salt water were given to the Australian Association for the Advancement of Science A man living in South Australia asked for a water analysis and it was found that it contained 1 1/7 ounces of solids, mainly salt, to the gallon. This is well beyond the limit set by the desert laboratory of U S. A. as the maximum for water capable of sustaining life even for a limited period. Yet this man had been drinking this water mostly in the form of tea, for three months

A Direct Motor-Driven Tenoner Saw

A SAW tenoner which may be operated without a countershaft or belts and which may be set and operated without regard to shafting is a new product of a Massachusetts manufacturer.

In place of the pulleys an alternating current motor with a speed of 3,450 r p.m is mounted on each saw arbor. The housing of each motor is made a part of the yoke which carries the saw arbor and bearings. The carriage is equipped with ball bearing wheels that operate on a double track supported on a knee that is raised and lowered by a handwheel

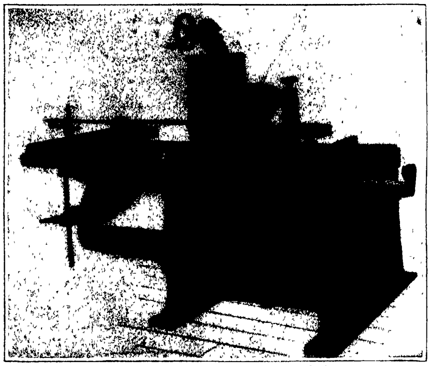
The table may be tilted either above or below the center and locked at any angle up to 22 degrees. The top and bottom saw arbors are mounted in yokes raised and lowered by elevating screws operated by handwheels. The yoke that carries the top saw arbor has a horizontal adjustment to line up the top saw with the bottom saw or to cut an offset tenon if desired The vertical arbor carrying the splitting saws is mounted on a yoke which has a horizontal adjustment to move the saws to and from the work.

Tenons from 3/16 inch to 8 inches thick and up to 6½ inches in length may be cut at one operation. Saw cut tenons have a better surface for holding glue and tighter joints are a result. Starting switches mounted on the machine start and stop, independently, the motors By eliminating the belting and countershafts a great saving in floor space is effected.

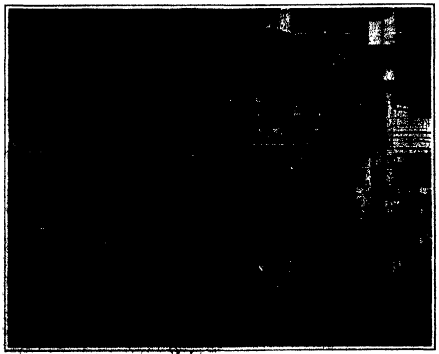
A Press of Imposing Proportions

SOME idea of the machine processes employed in the production of the modern automobile and motor truck may be got from the accompanying photograph, which shows an enormous press used in the blanking-out and perforating of the side rails for the largest size of motor truck frames. It can, however, be used for other purposes, and even for forming operations. This press is twin-driven and triple-geared, the gears being of steel. The bed is 252 x 48 inches; the slide face 242 x 40 inches; the total height is 25 feet 9 inches. The normal speed of the press is five strokes per minute. The truck chassis shown in the photograph was posed for the purpose of giving some idea of the size of the press, and seems to do this about as effectively as it could be done.

Machine for bending heavy plates for the hulls of big ships. It is used to scarf simultaneously both corners of a very long and unusually thick steel plate. Note relative size of man



The shaftless motor-driven tenoning saw outfit, which cuts tenons from 3/16-inch to 3 inches thick and up to 6½ inches in length at one operation



Big press used in motor-truck manufacture, and the way it sizes up against its product. The normal working speed of this press is five strokes per minute for forming and perforating heavy frames

The Current Scientific American Monthly

AMONG the contestants of the Einstein prize was one of our leading astronomers, Dr William H. Pickering of the Harvard College Observatory in Jamaica. Dr Pickering contributed two essays, both of which impressed the judges as being scientific critiques of the relativity hypothesis rather than popular explanations within the intent of the contest It goes without saying, however, that they are both very interesting and authoritative and are written in a clear and simple style In one of these essays Dr. Pickering writes as a physicist, and in the other as an astronomer. In both he conveys the impression that while he recognizes the importance of the Einstein theories and stands ready to give them every fair hearing he regards them as still unproved in full The two essays have been welded into a single article, which is published in the April issue of the Scientific American Monthly

A very useful article for those who are interested in meteorology, as well as for the general amateur photographer, is one by Arthur I Weed, on Cloud Photography He gives full details of the construction of the necessary apparatus and their use so that anyone who wishes to may engage in the fascinating work of photographing the clouds

An important article on the field of biology bears the title "Why Roots Grow Downward" The modern statolithic theory of geotropism is fully explained The sensitiveness of the extreme point of the root to the stimulus gravity is due to the position of starch grains in the cells, which, under the influence of gravity, sink to the lower wall of the cell and induce growth in that direction.

During the war the shortage of explosives made it necessary for the Germans to search for other means to be employed in mining operations They reverted to a process that was tried out during the driving of the famous Simplon Tunnel In the excavation of this tunnel, cartridges of crude petroleum, soot and Kieselguhr were saturated with liquid oxygen and when ignited burned with explosive force These cartridges were greatly improved upon during the war, and they have recently been under investigation by the U S Bureau of Mines They are described in the current issue of the Scientific American Monthly

A very important article entitled "Industrial Applications of Hydrogen" was specially prepared for the Scientific American Monthly by Harry L Barnitz, Ph G This is one of the most complete surveys of the use of hydrogen in various industries and is fully illustrated with diagrams showing the manner of application of this most important gas

In the March issue of the Scientific American Monthly we published an article on Leonardo da Vinci as an inventor In the present issue there appears another article by the same author on Leonardo as an aviation engineer This is illustrated with diagrams from Leonardo's own manuscripts, showing his remarkable ingenuity and the anticipation of many modern aeronautic inventions

The British Government is fitting out twelve of its Handley-Page bombing machines with a new type of stabilizer invented by M Georges Aveline This stabilizer is part electric, part pneumatic and part aerodynamic It operates on the principle of a pendulum, a body of mercury in a circular channel serving as the pendulum, and ingenious means are provided for correcting the stabilizer against the action of centrifugal force. The construction has been very cleverly worked out.

Prof E W. Scripture has made an interesting study of the nature of vowel

(Continued on page 300)

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Chemicals in Japan

THE following is abstracted from the *British Board of Trade Journal* relative to Japan's imports and exports of chemicals

Chemicals the volume of imports of which has greatly increased in the past few years, are salicylic acid, caustic soda, cyanide of soda, soda ash, logwood extract, and aniline dyes

Chemicals which have been in over supply during 1919 are carbolic acid, soda ash, glue, caustic soda, and rosin

Owing to the difficulty of obtaining supplies from Europe, most of the above have been imported from the United States, while the following have been exclusively imported from there bichromate of potash, acetate of calcium, milk sugar, and aniline salt

The articles that have been imported more freely from Great Britain than from the United States are carbonate of ammonia, tartaric acid, white zinc, cyanide of soda, chloride of ammonia, gelatine, borate of soda, and citric acid

Peroxide of soda and cyanide of potassium have been exclusively imported from Great Britain

The following articles have been converted into export lines during the war, naphthaline acetic acid, calcium, zinc dust, and copper sulphate, as have also several potash compounds, such as chlorate of potash and chloride of potassium

Metal Conservation

IN considering the balance sheet aspect of scientific and industrial research we would do well to recall to what extent our personal safety and comfort depend upon the alloy steels, the non ferrous alloys and their heat treatment We not only have discontinued the practice of increasing the weight of vital parts to give them sufficient strength, but in some cases the size of such members has been decreased because heat treatment brings about changes which are responsible for a great increase in strength Heat treatment, until comparatively recently, was not carried with the requisite temperature control to guarantee uniform, dependable results The development of more sensitive pyrometers has made this control relatively simple, while at the same time new types of furnaces and pots greatly facilitate correct hardening Preheaters are now employed to conserve fuel by utilizing waste heat and to save time in the heat treating apparatus

Fish Scaling

FISH scaling is a defect in the enamel on sheet metal ware, which is responsible for large losses in manufacture The Bureau of Standards has been investigating causes and prevention of fish scaling, and a part of the research has to do with the effect of the shape of the metal vessel on the phenomenon noted Miniature basins are used for the test, and it has been found that certain portions of them consistently show fish scale. This is particularly true of the convex parts of the specimens Also flat plates show fish scale more than do basins, which are free to expand and contract The *thermal* expansion *of metals* used in this work and of rods made from various enamels is being determined From the work done so far it seems that the enamels show a critical contraction at about 450° to 500° C

Preservatives for Fermentable Beverage Samples

THE laboratories of the Ohio State Department of Health report the outcome of tests made by them with *various preservatives for fermentable beverage* samples intended for analysis The article appears in the *Journal of Industrial and Engineering Chemistry* for July, and the general conclusions are that sodium benzoate, present to the extent of 2 per cent, is unreliable as a preservative, that sodium bisulphite and boric acid, 2 per cent are of no value whatever, but that mercuric chloride and salicylic acid 2 per cent are satisfactory preservatives Because of the poisonous character and the expense of mercuric chloride, salicylic acid of 2 per cent strength is recommended as the preservative to be used when fermentable samples are to be tested for alcoholic content and when the immediate delivery of such samples to the laboratory is not possible

Experiments were carried on with various types of near beers, some with and some without yeast, a part of the material being bottled and other samples purchased from bulk. Some of the near beers would not ordinarily ferment even when open, while others did ferment rapidly unless a preservative were added.

Tensile Properties of Boiler Plate

AN investigation upon the tensile properties of boiler plate at elevated temperatures has been in progress at the Bureau of Standards, which has made the following partial report:

A quantity of boiler plate has been rolled at a blue heat (300° C) preparatory to determining the properties at elevated temperatures and also the effect of blue work on the tensile properties at normal temperatures The effect of low temperature annealing on plates worked below the thermal critical range will next be determined Special apparatus has also been constructed for the determination of the effect of rate of loading on the elastic limit at elevated temperatures This necessitates the use of a motion picture camera for obtaining records of constantly moving dials and constantly increasing loads. Trial runs have been made and several desired modifications have already been installed When finished, this investigation will yield more complete data than are now available concerning the effects of various thermal and mechanical treatments, below the thermal critical ranges, on the tensile properties of low carbon steel at temperatures up to about 470° C.

The Natural and Synthetic Compared

THE Committee on Therapeutic Research of the Council on Pharmacy and Chemistry of the American Medical Association conducted a study with a view to determining whether the so-called natural salicylic acid and salicylates have the superiority claimed for them as compared with synthetic products. The so-called natural products are derived from the oils of wintergreen or birch, whereas the synthetic materials are those provided by the organic research laboratory. The committee has concluded that, notwithstanding statements to be found in the older literature, no difference can be shown in the toxic dose for animals between sodium salicylate, natural or synthetic The evidence for the difference claimed is not to be found in a clear and conclusive form in the medical literature, and synthetic salicylate has not been found to contain significant chemical impurities.

Consequently no difference can be detected either in the therapeutic or toxic effects between the natural and the synthetic products, if the tests are made under the conditions which eliminate the personal factor.

There are a number of salicylates now familiar to nearly everyone. Acetyl salicylic acid is more familiarly known as aspirin, a term that at one time was considered the exclusive property of one manufacturer, but which has now become a word common to the language and generally applied to the compound. Sodium salicylate is not irritating and is more rapidly absorbed than salicylic acid. Ammonium salicylate is popular. It is said to be tolerated by the stomach better than sodium salicylate. Lithium salicylate is largely used in rheumatic conditions, as it combines the effects of both lithium and salicylic acid. Another salt of salicylic acid is magnesium salicylate, and strontium salicylate is also familiar to the physician. Methyl salicylate is the artificial oil of wintergreen.

Temperature Control

A SERIES of popularly written advertisements based upon scientific facts and history remind us of the increasing extent to which we are dependent upon the control of temperature. The control of temperature finds its way into nearly every industry, and it affects our health and life because upon it is based pasteurization, sterilization and other processes which [illegible] controlled to a degree. Even in the pre[illegible] food the control of temperature is playing [illegible]tant part, and cook books, which in many respects are delightfully vague, are beginning to introduce standards of temperature for boiling and baking. This is especially true where work is on a large scale, and is one of the factors upon which the success of the large canner, for example, depends to a great degree. No housewife is considered a failure because one jar in a dozen "works," but if one jar in a dozen, which is purchased, is found to have fermented there is trouble at once.

It is due largely to the control of temperature that we have been able to produce a wonderful range of synthetic colors, and in the dye factory temperature recording and controlling instruments are in evidence everywhere. The earliest experiments in refrigeration have been attributed to the Romans, who placed a bottle of wine in another vessel containing water, into which saltpeter was added slowly while the bottle was rotated. In India the temperature is sometimes reduced by the rapid evaporation of water scattered over twigs or other mediums to give a large surface, and evaporation does the rest. But in modern refrigerating plants it is the thermometer that measures the degree of cold, so that it may be kept uniform without the waste of energy. In the rubber industry, in the metal industry, in the manufacture of glass, etc., etc., it is temperature control that does so much for us, and throughout our chemical work temperature is one of the dominant factors. It is easy to understand why scientists generally are very particular about their thermometers.

Sixth National Exposition of the Chemical Industries

THE announcement of the Sixth National Exposition of the Chemical Industries to be held the week of September 20-25 inclusive at the Grand Central Palace, New York, reminds us how rapidly the chemical industry in America has developed since the first exposition in 1915 when eighty-three manufacturers took part in an exhibit designed to show America what progress had been made by the chemical industries here. The number of exhibitors has increased year by year, three hundred and fifteen participating in the exposition held last year at Chicago At the present time three hundred and fifty-eight exhibitors have taken space requiring four floors of the Grand Central Palace to be utilised for the purpose. The increase has not been confined to a number of exhibitors, for the public at large has shown a growing interest There were sixty-three thousand in attendance during the first exhibit and one hundred and eleven thousand last year. There will be three special sections this year, the first being the Electrical Furnace Section, the second, the Fuel Economy Section, designed to show to advantage the various apparatus which assist in economic utilization of fuel, and third, the Materials Handling Section, which will show machinery of all kinds for conveying, transporting and otherwise handling materials.

Chemists and scientists in general are anxious to have the public fully utilise such opportunities as the exhibit affords to grasp the significance of the chemical industry in the United States. When such an understanding has been reached chemists may look for the type of legislation to be enacted which will encourage the industry

American Potash Industry

NOTWITHSTANDING the fact that the fertiliser mixing season of the spring has closed, the American potash plants are running full time on contracts which in many cases will insure continuous operation to the close of the year. This is an encouraging situation and is due principally to the situation abroad. German sulfate of potassium sold at $4 a unit all last winter and spring, and the German companies were able to pay 20 per cent dividends as the result of their 1919 export business to America. The French producers have also obtained as high a price as possible from the American importers, and it is apparent that unless there is some domestic competition America will be permitted to pay a price which may equal the $7 a unit, which the American farmers were required to pay during the war. However, the present favorable condition of the industry does not mean that it has finally come to a sound permanent basis. The Europeans could, of course, swamp the American market if they were back to normal producing conditions, and it becomes an economic question to what extent we can afford to pay American producers to establish an industry that will protect the farming and other industries from excessive prices in Europe.

The One-Man Airplane for Everybody's Pocketbook

THE de Pischof avionette, recently flown in France with good results, represents the latest attempt to produce a small airplane of inexpensive construction and low operating costs. This diminutive airplane, which is shown in the accompanying illustration, is built entirely of metal and has a factor of safety of 9, with a total weight of 280 pounds. This reduced weight, with the high coefficient of safety, has not been obtained merely by boiling down an ordinary airplane, so to speak. Instead, the designer has reduced the number of working parts to a minimum while at the same time making each component perform as many objects as possible.

In a light machine the ordinary undercarriage is unnecessary. Experience has proved that the ordinary pneumatic tires absorb practically all shocks. So in the present de Pischof avionette this fact has permitted the use, as an axle, of the central section of the front spar of the lower plane, which provides the point of attachment for the lower planes, and for the bracings of the wing cellule, and also acts as the axis for the rudder pedals

The engine is a two-cylinder horizontally opposed air-cooled 18-horsepower Clerget-Blin type, driving the tractor screw. The avionette has made 62 miles per hour in test flights, with a gasoline consumption of 11.2 gallons. It has climbed 3,700 feet in 52 minutes. In spite of its reduced dimensions and lightness, the machine is claimed to be extremely stable and quite controllable.

Reconstruction in Invaded Regions of France

THE Ministry of the Liberated Regions of France furnishes the following information relative to the resumption of operations by industrial establishments located in the liberated regions, employing over 20 persons: Up to August 1, 1920, 4,096 industrial establishments were noted in the census taken by the Government. Of this number 3,106, or 75.8 per cent, announced that they had resumed operations in whole or in part. In the Department of Meurthe and Moselle 82.2 per cent of the establishments had resumed operations, in the Ardennes 81.8 per cent were operating, and in the Department of the North the proportion attained 80 per cent. The city of Lille and the outlying districts show a remarkable increase in activity during the past year, 86.2 per cent of the industrial establishments having resumed business It should be pointed out that a large proportion of these establishments are operating with only a small part of their normal equipment of men and machinery.

The 3,106 establishments included in the census employed 757,888 workers in 1914. On August 1, 1920, they employed 325,490 workers, or 42.9 per cent, of the normal number of employees. It is interesting to note that in July, 1919, the proportion of workers was only 9.7 per cent. In the textile, metal-working, and pottery industries almost one-half of the normal number of workers have returned by this writing, despite business depression.

Radium's Discoverer and Her Gift from American Women

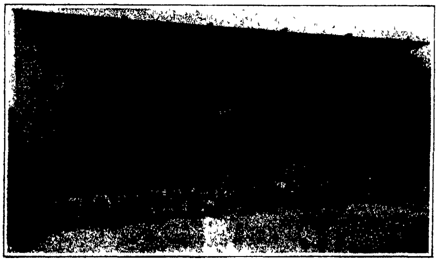
WHEN Mme. Curie arrives the middle of May she will bring her eldest daughter, aged twenty. Mlle. Irene Curie is one of her mother's ablest pupils and a faithful assistant in her laboratory. Mme. Curie's sister has also become a distinguished woman of science. This sister, a doctor of medicine, together with Kasimiers Dluski, is head of a sanitarium at beautiful Zakopane, in the Tatra Mountains. She has won recognition from the Polish republic for devoted and patriotic service, and her associate, Dr K. Dluski, represented General Pilsudski, Poland's President, at Versailles Mme. Curie's brother, Dr. R. Sklodowski, is one of the leading physicians in Warsaw.

When the gram of radium which Mme. Curie is to receive at the hands of the women of America is once in her possession she will be responsible for the safety of the $100,000 present. The greatest danger of all in the handling and transport of such a minute substance is that it might be lost, as once happened to the distinguished scientist, M. Becquerel, who let fall into a fold of his clothing, where it could not be found, an infinitesimal portion, which represented a considerable fraction of the whole supply then in France

The French Radium Institute has been studying this phase of the American offer for several weeks, and after measuring the penetrating power of smaller particles of radium, scientists of the institute have decided that the gram must be divided into twelve or fifteen ampoules according to a cablegram just received [illegible] the *New York Herald* Each of th[illegible] be surrounded by a platinum sheath a thirty-second of an inch thick and encased in lead. The whole will then be sealed in a lead casket and placed in a separate safe in the ship's ice box

Despite its lightness and small dimensions, this de Pischof avionette is remarkably steady while in flight

Cyclecar equipped with six-horsepower motorcycle engine and steered by pulleys and cables



Hotel for horses located in the suburbs of Berlin, with its tenants and its uniformed attendants

Landing gear taken from a German airplane, showing the wire wheels fitted with wooden rims bound with steel bands

Fast Climbing with a Freak Automobile

AT a recent hill climbing contest held in France a curious cyclecar or diminutive automobile, whichever you wish to call it, made over 60 miles an hour on 10 per cent grade The machine, known as the "Spider" because of its light construction, is driven by a 6-horsepower, twin-cylinder, V-type motorcycle engine mounted at the rear It is steered by pulleys and cables in very much the same manner as the usual airplane The driver's legs extend into the hood of the machine while the passenger's legs and feet rest on side pieces

A Hotel for Horses

IN that section of Berlin known as Charlottenburg there is a veritable hotel for horses This hotel—if we may be permitted to call even a de luxe stable a hotel—provides luxurious quarters for the horses of a Berlin bus company, as well as rents rooms by the day, week or year for horses visiting or staying permanently in the city The structure, which is of brick, is three stories high On each floor there is a roomy balcony running the full length of the building and available for exercising the horses. An inclined runway connects with all balconies, as shown in our illustration A corps of uniformed attendants look after the horses and give them every care and attention that efficient hotel service can devise.

Wooden Wheels for Rubberless German Airplanes

DESPITE all that has been said of German substitutes for rubber, it appears that blockaded Germany of wartime days had to improvise ways and means of getting along without that important material. A case in point is tires for airplanes, of which the accompanying photograph is typical. Toward the end of the war numerous German airplanes were provided with all-metal landing wheels or wheels of wire and wood construction The accompanying photograph shows one of the landing carriages of a large German airplane, equipped with wire wheels and wooden rims encircled by steel bands Since the shock in landing is largely absorbed by the pneumatic tires, it follows that this improvised arrangement must have proved unsatisfactory and resulted in more breakage than is usually the case.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

The air cylinders force this hoist to ease its user to the ground gently in the event of fire

A Compressed-Air Fire Escape

AMONG recent German inventions is our good old friend the individual fire escape about which so many jokes have revolved *The present invention*, however, has a feature of novelty that entitles it to mention here, and that suggests the possibility that perhaps it should be taken seriously As our illustration shows, it is of the type which provides a hoist to lower its user to safety from the window, to the frame of which it must be attached in advance The interesting item is the use of compressed air cylinders to ease the drop and make it at once safe and rapid After duly attaching the belt, the user turns on the air, and sufficient resistance is afforded by the piston to the turning of the sheaves on which the cable runs to insure that he be deposited with sufficient gentleness to avoid broken bones The entire apparatus weighs no more than 25 pounds, and is accordingly easily transportable —By *H Herzberg*

Newest Bait Bucket

AN air chamber within this bait bucket for fishermen makes possible its floating in water, submerged to the rim only There will be for this reason a constant circulation of fresh water for the minnows The cup seen on top of the bucket is for holding an immediate supply of bait only. This has a bottom which is also a float and which, by its buoyancy, keeps the opening closed against the entrance of other minnows.

A handy live-bait bucket which floats in water

An Automatic-Stop Drill

THE portable grinder shown in the accompanying illustration is motor-driven using either alternating or direct current, and automatically stops when not in use This is due to the fact that the current contact functions through a spring lever in the handle which is released as soon as the pressure of the operator's grip is removed, much on the same order as the valve on a pneumatic hammer or on the same principle as the "dead man" grip controller used on many of our electric railways

A portable drill of very much the same design is also available with the same style of control In either equipment the motor has been designed to withstand severe use and overloading for this class of service often calls for extremely heavy loads on the motor for short intervals

New Pins from Old

ELECTRIC DRIVEN rotary brushes are nothing new, but new uses for them are being found all the time Our picture shows the use which an ingenious pin boy in a big bowling alley has made of one which was installed, in the first instance, to keep the alley floors in prime shape; and it ought to contain a suggestion of some value in a good many other but similar directions.—By *U O Underwood*

Renovating the bowler's pin with the electric floor-brush

Motor Trucks and Road Wear

THERE is a special field of transportation in which the motor truck is the only logical means of conveyance How large a field it is, is shown by the fact that 300,000,000 tons of material were shipped by truck in 1919 Suppose this freight were transported in one-ton trucks It would mean that 900,000,000 tons of traffic (including weight of vehicles and cargo) would pass over the roads of this country. If *transported in* 7½-ton trucks *the roads* would have to bear only 600,000,000 tons of traffic This is because the average one-ton truck carries two tons of vehicle weight for every ton of freight transported while in a 7½-ton truck this ratio is reduced to less than one ton of vehicle weight for each ton of freight capacity Regardless of what form restrictive legislation may take the total amount of material shipped in motor trucks in 1920 will obviously be greater than the total for 1919. This country is suffering from various kinds of shortages but they are almost all directly the result of inadequate transportation. Since no other transportation agency can now take the place of the motor truck in its own recognized sphere, it is obvious that every heavy duty truck barred from the roads will be replaced by several smaller trucks The result will be increased road wear and increased cost of transportation. As practically all products of the farm and factory make some part of their journey from producer to consumer in motor trucks, it is necessary to make sure *there is no other alternative before* framing legislation which will increase motor transportation costs

There are many fields of short distance light delivery in which the lighter truck is better adapted However, when bulk hauling is considered, the light truck's greatest asset in comparison with its big brother is its speed. For a two-ton truck to transport material as economically as a heavy duty model it would be necessary for it to travel at three times the speed of the larger truck Of course the light truck cannot do this but it does travel at a considerably higher normal speed Its increased speed, however, produces road wear in excess of that caused by the heavy truck in spite of the fact that the latter is accomplishing far more It has been definitely proved that increased speed causes more rapid road wear than *increased weight It is not necessary* that the heavy duty truck resort to destructive road speeds in order to furnish economical transportation.

Gripping the handle of this electric grinder starts the wheel

Tire width bears an equally important relation to comparative road wear A steam roller for example is about the heaviest vehicle which passes over a highway, yet because of its broad road bearing surface its effect on the roadway is beneficial rather than harmful. Likewise weight in a motor truck is destructive only when not accompanied by a sufficient width of tire. The fact is well established that a load of 800 pounds per inch of tire surface is not damaging to an ordinary roadway and the heavy duty truck is always built to conform to this requirement. A 7½-ton truck has one inch of tire width for each 666 pounds of weight.

If restrictive motor truck legislation is necessary and it undoubtedly is, why not proceed on a basis which penalizes actual road wear rather than one which penalizes utility and determine by actual test and far reaching analysis just where the blame for excessive road wear belongs? Then and only then will the judgment be a permanent benefit to the growth of highway transportation and its relation to public welfare.

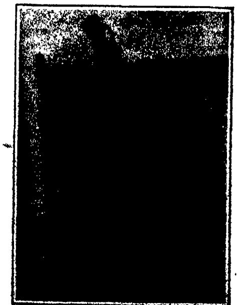
Shoe brush with the polish right on tap

The Polish in the Brush

IF one of your New Year resolutions was to shine them yourself, this combination brush and polish, all in one article, will make the work easier and keep your fingers from becoming smeared with polish. Beneath the metal cover of the brush is a tube of shoe polish much as dentifrice is put up. By turning the key which projects through the slot along the side, as much or as little of the polish as desired will find its way into the end of the tube projecting from the metal cover.—By *K. H. Hamilton*

The Automatic Life Buoy

YOUR Uncle Samuel's big naval craft have just been outfitted with a new and interesting style of life buoy. The novel features of this buoy are two. In the first place, it is so installed on the ship that by the pressing of a button from the bridge, a number of the buoys are at once released and launched into the water In the second place, as soon as a buoy strikes the sea, a big flare bursts out and burns until the buoy is picked up again In this way, when the cry "Man overboard" goes up, it is expected to reduce to a practical zero the chances of the unfortunate sailor missing the buoys, or of the ship missing him —By *Ralph Howard*.



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The new life-buoy of the American Navy

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRPLANE.—W. L. Denham, 1125 12th Ave. N. Birmingham, Ala. Among the objects of the invention is the provision of a machine embodying airplanes having rotation about an orbit or point stationary with respect to the body or fuselage of the machine in order to apply a direct lifting force and enable the machine to proceed to climb or descend, under control as desired, upon an even keel, or in other words without tilting as required in the present type of airplane.

MOTOR MOUNTING FOR AERIAL VEHICLES.—V. E. Jossenberger, 4854 Prospect Ave., Los Angeles, Cal. The object of the invention is to provide a motor mounting of such form that the axes of the propeller may be shifted to shift the plane of the propeller and the direction of the pull, to overcome emergencies of every character, such as, for instance, to right the machine in nose dives, nose spins, tail spins, side slip, and for permitting the machine to be extricated from air pockets and to assist in rising and landing.

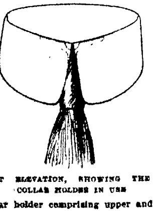
AIRPLANE.—C. H. Georgi, 14 E 30th St, New York, N. Y. This invention relates particularly to an arrangement of planes and adjusting means therefor, and has for an object to provide mechanism whereby the angle of incidence may be changed at any time, the structure being so formed that none of the parts of the airplane are weakened or reduced in efficiency. A further object is to provide means whereby an easy landing may be made, by a high speed machine, and a bracing effect produced at the time of landing or while in flight.

Pertaining to Apparel

ADJUSTABLE BELT—T Jansen, 700 West End Ave., New York, N Y The invention relates to belts for wearing apparel and has particular reference to means for varying the effective length of the belt so as to fit it to persons of different sizes. Among the objects is to provide a belt having peculiarly housed resilient members, stop means being provided to prevent the over-stretching of these resilient members, and provision being made for complete separation in case of repair, or the like.

NECKTIE FORM—L F. Caumont, 98 3rd Ave, New York, N. Y The general object of the invention is to provide a necktie form for use in forming four-in-hand knots by the individual user, even if unskilled in tying four-in-hand neckties, and more particularly the invention relates to a former for directly applying the formed tie with the former to the collar and securing the same to the collar button without passing the band of the necktie above the collar.

SOFT COLLAR HOLDER.—J. O'Connor, 437 W. 43rd St., New York, N Y This invention relates to a device for holding soft collars in a manner to maintain the collar in proper set The general object is to provide a soft collar holder comprising upper and lower sections adjustably connected, and at the same time to provide button engaging means in fixed relative position, and unaffected by the adjustment of the supporting wings or lateral arms for holding the collar flaps.


A FRONT ELEVATION, SHOWING THE SOFT COLLAR HOLDER IN USE

NECKTIE AND SECURING MEANS THEREFOR.—E. Bliss, 731 Plum St., Vineland, N. J. The invention relates to means on which the knot of a necktie is formed, said means embodying the elements for engaging the collar button and for entrance beneath the front of the collar. The general object of the invention is to provide a necktie and attaching means of the indicated character, which is durable, said securing means being formed of wire

Electrical Devices

AUTOMATIC DOOR OPENER. — C. F. Young, 3952 Ludlow St, Philadelphia, Pa The invention particularly relates to door openers applicable to garages. An object is to provide an electrically controlled contrivance for automatically opening doors in which means are provided so that the door cannot stall during its movement Another object is to provide a simple and inexpensive device which can be easily applied to existing doors of the swinging type

DRY CELL BATTERY.—H. M Korstsky and B. H Teitelbaum, c/o Bright Star Battery Co, 310 Hudson St, New York, N Y This invention relates to dry cell batteries in which the electric agents of the battery are normally spaced from each other or inactive for an indefinite length of time, up to the time the battery is put into use, and whereby the devices are not subject to deterioration during the interval of time elapsing between the time of manufacture and the time of use

TANK SIGNAL.—E E. Pierce, Hackley School, Tarrytown, N. Y An object of the invention is to provide a signal device for gasoline and other tanks, which may have an indicating member on the front dash of an automobile or at any other convenient point, and electrically operated whenever the manually operated switch is closed for indicating the level of fuel in the supply tank, the electric current being used only when giving the signal.

TRANSMITTER—M. R Myers, Afton Star Enterprise, Afton, Iowa. The invention has for its object to provide a transmitter especially adapted to withstand heavy currents of electricity such as are used in wireless telephony. A further object is to provide a transmitter that can be used from any angle and for this reason is especially adapted for use with flying machines.

FREQUENCY-SELECTING RECEIVING CIRCUIT—F E Pernot, c/o Cosmos Club, Washington, D C An object of the invention is to provide a receiving circuit tuned to receive one or more predetermined tone frequencies to the substantial exclusion of all other frequencies thereby preventing interference A further object is to provide for the simultaneous reception at a single station of several tone frequencies from one or more sources

GROUND CLAMP—P Windman, 106 Kearney Ave, Perth Amboy, N J The general object of the invention is to provide a clamp for the purpose of grounding an electric conductor on a pipe or equivalent grounded element. A more specific object is the provision of a ground clamp formed of a strip of metal, one extremity of the strip being shaped into a socket for receiving the electric conductor, the point of juncture of the socket with the flat portion of the strip being so shaped as to give the desired rigidity to the socket to which the electric conductor is anchored

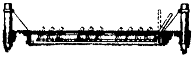
RECORDING INSTRUMENT—O T Alexander, 1228 45th St, Altonpark, Tenn The invention relates more particularly to an electrically-controlled recording device designed for use on electric pushing and leveling machines of by-product coke ovens and the like to record the time of, and the relative amount of, current in each horsepower required on each oven operated A further object is to provide an instrument which in its dual capacity will register the time of pushing and the leveling operations as well as the current used

Of Interest to Farmers

GRAIN DRIER—W Putnam and G. D Longman, 2019 Ryan St, Lake Charles, La. An object of this invention is to provide an apparatus which is designed to dry or cure an unlimited quantity of grain directly as it comes from the field and before it is threshed. It is especially adapted for curing rice, but may be used for other grain, resulting in the prevention of great loss from wet weather

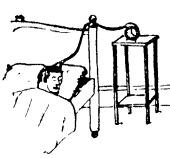
STOCK LIFT.—O E Hatch, Box 465, Davenport, Iowa. The invention relates to a stock lifter which is readily portable so that it may be set up at any place desired, to lift and support an animal. An object is to provide a construction of hammock with a frame supporting and guiding the same, and provide levers at the corners of the frame which can be conveniently manipulated to give the desired elevation

GATE—F A Garcia, R F D No 2, Box 137A, Pueblo, Cal The invention has for its object to provide a gate adapted to be used within a pit, to form a covering or supporting surface level with the top of the pit, or to form an open work structure for deterring the passage of stock and the like, the structure may be quickly thrown into or out of position for the passage of vehicles or for proving an obstruction for stock.


A SECTIONAL VIEW OF THE GATE

Of General Interest

ALARM CLOCK—C W. Waller, 5414 So Wells St, Chicago, Ill The object of this invention is to provide mechanism for use in connection with an alarm clock for converting such clock into a noiseless alarm, whose sound will carry only to one person whom it is desired to waken To accomplish this ear pieces are engaged with such persons' ears that the sound vibrators may be carried by a flexible tube directly to the users' ears, the clock being constructed in such manner as to be practically noiseless to others.


SHOWING THE CLOCK IN USE

PORT SCREEN.—T J Boyan, c/o W B Roe, 55 Bayswater St., Boston, Mass The purpose of the invention is to provide a port-hole screen closure to prevent the entrance of insects, the closure being used in combination with a ship's port hole, and port hole cover so that the cover may be dogged down with the screen closure in position A further object is to make a screen insert construction in the form of a plug capable of being easily inserted or removed

COMPOUND FOR THE AUTOMATIC REMOVAL OF COPPER FROM ORDNANCE—A E A Dagory, Bois Colombes, Seine, Avenue Robert Bain, No 8, France The invention relates to a compound for automatically freeing guns of all calibers from the copper which is deposited, during the firing, in the interior of the bore The compound used consists of an explosive material and an alloy of tin 55 per cent and lead, 45 per cent

CAMERA—N F Brown, 22 Washington St, Grand Haven, Mich The purpose of the invention is to provide a camera which can be built up cheaply of cardboard or other sheet material, cut in blank form in such a manner that it may be folded flat to remain convenient for carrying until required for use when it may be formed into a temporary camera by joining the edges with flexible gummed binding strips The camera is so constructed as to use the well known daylight loading photographic film packs

WATERPROOF CIGARETTE CASE—S V Roos and M Josephs, 715 W. 170th St, New York, N Y An object of the invention is to produce a moisture and waterproof cigarette, cigar and match case for bathers' use in order that swimmers and bathers may be able to conveniently carry such articles A further object is to provide such a case, which will be comparatively inexpensive, strong and light in weight

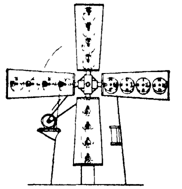
FOOD PRODUCT AND PROCESS OF MAKING SAME—R. de O McDill, Box 198, Tampa, Fla Two patents of a similar nature have been granted to this inventor The inventions relate to the preparation of a pomace in a dry state from fruits, to be used in making marshmallows, jams, and jellies, so that all that is required is to cook and soak the pomace, strain off the juice and cook the resultant juice with sugar in the manufacture of jelly. In the manufacture of marmalade and jam the operation is the same except that the pomace is incorporated when cooked with the sugar as in the standard practice in making such foods from fresh fruits

ATTACHMENT FOR BATHTUBS—I T. Skiles, 3703 E 10th St, Long Beach, Cal. The invention has for its object to provide mechanism in connection with the outlets of a bathtub for simultaneously controlling the waste and the discharge, and so connected that when the waste is open the discharge is closed and when the discharge is open the waste is closed.

STIRRUP LEATHER FASTENER FOR SADDLES—C B. Settles, Delphin, Mont. One of the principal objects of this invention is to provide a metal fastener for use particularly in connection with wide leathers found commonly on stock saddles, for quickly and adjustably connecting the ends of the stirrup leathers, thereby doing away with the use of the leather strings or laces usually employed for this purpose

MANUFACTURE OF HYDROGEN BY MEANS OF SILICON AND ITS ALLOYS—G F Jaubert, 155 Boulevard Malesherbes, Paris, France According to this invention the method of manufacturing hydrogen consists in mixing equal volumes of ferro silicon in the state of powder and water, in stirring the said mixture in order to eliminate phosphids, and in injecting the semi pasty liquid of ferro-silicon obtained into a hydrogen generator containing caustic alkali, either above or below the alkaline liquid

ADVERTISING DEVICE—C D Bowers, 318 W 57th St, New York N Y The special object of the invention is the provision of a movable device simulating a Dutch windmill, upon each arm or blade of which are pivoted a series of disks, each disk bearing a plurality of characters adapted to be brought into display position in succession as a result of the revolution of the disk with the arm around the axis of the wheel and the simultaneous rotation of each disk on its own axis.


A FRONT ELEVATION OF THE DEVICE

COMBINATION DRIPPER AND STEEPER.—G H. Nicholls, Box 536, Beaumont, Texas. The object of this invention is to provide a device for preparing beverages such as tea and coffee, wherein a strainer is provided for supporting the material to be steeped, and the said strainer having means for engaging the top of a tea or coffee pot to support the strainer with the material to be steeped in the water or out of the same

SUPPORT OR HOLDER.—R F Ferguson, Northville, Mich This invention has for its object to provide a device of the character specified, of ornamental construction, adapted for supporting a safety razor and the blades in convenient position for use when desired, and which may be suspended from the wall or stood upon a dressing table or the like

OUTFIT FOR PRODUCING BEVERAGES—H Schnackenberg, Cresco, Pa. The invention relates to an outfit comprising individual drinking cups as well as ingredients for the production of an aerated or other soft drink or the like, by the addition of water The object is to provide a unit in which the two nested cups form a chamber containing the ingredients for the beverage, the chamber being airtight and moist proof

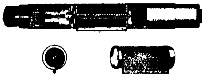
REEL HOLDER.—C. I. ANDERSON, Box 255, Fort Bragg, Cal. The invention has particular reference to a device for holding fish reels. The prime object is to provide a holder which is so constructed as to render the same adapted to readily receive a winding reel so that the line may be wound upon the reel in an easy manner, and that the reel may be interchangeable.

CHEESE CUTTER.—I. S. KARRAS and L. H. BRIDWELL, 109 Cypress St., Brinkley, Ark. Among the objects of the invention is to provide a clean and sanitary device supporting the cheese in an enclosed receptacle, and to provide means for cutting the cheese in slices as may be desired. The table on which the cheese is supported is provided with rotary movement, and V shaped recess through which the cheese falls as cut.

FOUNTAIN MARKING BRUSH.—M. M. SHACKITT, 1922 Pitkin Ave., Brooklyn, N. Y. Among the objects of the invention is to provide a fountain brush more especially designed for use in marking boxes, cases, packages or other articles, and arranged to enable the user to readily carry the device about on his person for use whenever necessary. Another object is to enable the user to temporarily support the brush and thereby have the free use of both his hands.

SEDIMENT REMOVER.—D. AKERS, 301 Broad St., Carlstadt, N. J. The invention relates to plumbing equipments in the form of a removable strainer. An object is to provide a sediment remover more particularly for use in connection with hot water boilers. The device is comparatively inexpensive to manufacture and may be quickly installed for use on hot water systems generally found in the home.

SHOE POLISHING DEVICE.—C. VANDERBILT, JR., c/o Ten Eyck Hotel, Albany, N. Y. An object of the invention is to provide a device which is relatively small and compact and may be conveniently carried in the pocket or in a bag while traveling. A further object is to provide a device having mounting for a polishing strip and for brushes or daubers so that all of the parts may be conveniently positioned for use, and when not desired for use will be enclosed so that they will be neat and clean for handling and will not injure or soil other articles.


A SECTION VIEW OF THE INVENTION AND PERSPECTIVE VIEW OF POLISHING STRIP

CONCRETE WALL CONSTRUCTION.—W. C. BUCKHOUT, Lincoln Station, Yonkers, N. Y. Among the objects of this invention is to provide a wall in which a minimum of concrete is employed and which will be quickly dried out by reason of the air circulation therethrough. A further object is to provide a wall which can be constructed without forms of any kind and which will have an interior drainage and ventilating system.

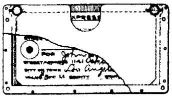
SAFETY CLASP FOR PINS, BUTTONS AND THE LIKE.—F. DRISSLER, 206 Broadway, New York, N. Y. The invention relates to holding devices for badges and other similar devices and has for its object to provide a construction which will be very effective when in position, but which is easily applied and removed. Another object is to provide a safety holder which will hold the pin or button in place without changing the position or disturbing its usual appearance.

SAFETY RAZOR.—I. CLAIR, 1035 53rd St., Brooklyn, N. Y. The invention aims more particularly to provide a device in which all possibility of the user cutting himself is eliminated. A further object is the provision of means whereby the corners of the razor are protected, and by reason of such guard the corners are kept out of cutting contact with the surface of the skin at all times, although the cutting blade is in proper contact with the surface of the skin.

WALL CONSTRUCTION.—H. J. LAFONTAINE, 5641 Cottage Grove Ave., Chicago, Ill. An object of this invention is to provide a wall construction which is made up of hardened slabs of plastic material, these slabs being secured to suitable supports, so as to form a wall at relatively low cost. A further object is to provide a construction in which the slabs are overlapped in such a manner as to prevent the passage of moisture between the joints.

FLYING TARGET.—A. MCMILLAN, 40 Bayard Lane, Princeton, N. J. An object of the invention is to provide a flying target which can be used over and over again without its utility being impaired. Another object resides in the provision of means whereby the target when struck by shot will be separated into several parts and thereby fall indicating a hit, at the same time it is so constructed as to be readily reassembled without damage.

TAG HOLDER.—J. J. WOLFF, 227 Alexander Ave., New York, N. Y. An object of the invention is to provide a holding device for tags, identification cards and the like, means being provided for thoroughly protecting the tag against injury. A further object is to provide a construction which may be placed on almost any part of a trunk or other article, and will at the same time be out of the way although permitting of ready insertion or removal of the tag, but preventing accidental loss thereof.


A PLAN VIEW, PARTS BEING BROKEN AWAY TO DISCLOSE THE INVENTION

LOCKING DEVICE FOR INDEX CARDS.—H. C. JONES, c/o Lemon Cove Hotel, Lemon Cove, Cal. The purpose of the invention is the provision of index cards having locking means carried thereby for positively securing the card to the rod in a manner to eliminate the necessity of completely or partly removing the rod from the filing case in effecting the insertion or removal of a card.

INTERLOCKING HEAVY SERVICE BLOCK FLOORING.—J. D. BUTLER, 6650 City Ave., Philadelphia, Pa. The invention relates to paving adapted for extreme strength under heavy service. Among the objects is to provide means for the expeditious and permanent laying of wooden blocks with the grain arranged vertically, and interlocking mechanism for the wooden blocks comprising tongue and slot members adapted for longitudinal mating, each block being fitted on opposite sides with a pair of said interlocking members.

DIVING APPARATUS.—A. E. CHRISHOLM, c/o Chesley Tug and Barge Co., 4 Ferry Bldg., Seattle, Wash. This invention is especially adapted for use in deep sea diving. An important object is to provide apparatus which is adapted to be suspended and lowered from a ship or barge in such manner that it will not partake of improper turning movement, and will be shifted in accordance with the movements of the ship or barge. A holding or grappling means is provided which may be easily operated from the interior of the casing of the apparatus.

VANITY CASE FOR HANDBAGS.—M. WIENER, c/o Wiener Bros., 325 5th Ave., New York, N. Y. It is the primary object of this invention to construct a vanity case in such manner that the same is permanently secured within a handbag. It is a further object to pivotally mount a vanity case within a bag in such manner that movement of the case about its pivotal point will effect the opening of the case.

ROD SPLICER.—C. A. NELSON, Carver, Minn. The invention relates more particularly to splicing reinforcing rods for concrete. The object is to supply a rigid splice whereby there is no danger of slipping when cast with concrete. Another object is to provide a splice which can be quickly adjusted and then firmly clamped.

SLIDING NAME REGISTER.—L. M. A. HAUGHWOUT, c/o Essenstein & Haughwout, 2 Rector St., New York, N. Y. The object of the invention is to provide a sliding name register which indicates the presence or absence of the person indicated on the name plate, in large assemblies such as schools, churches, offices, hotels and manufacturing concerns, indicating the names of all persons present in one column and those absent in another column.

Hardware and Tools

LIFTER FOR COOKING VESSELS.—H. L. ANGUS, Inverness, Mont. A purpose of this invention is the provision of a lifter of simple, durable and efficient construction which includes coöperating jaws that are adapted to be actuated to firmly embrace a vessel for manually lifting the same, one of such jaws being locked when in the operative position to prevent the vessel accidentally slipping while being carried by the lifter.

HOSE COUPLING.—L. STEIN and L. BRUMMER, address B. Hartstein, 209 Broadway, New York, N. Y. The prime object of the invention is to so construct a hose clamp that various degrees of adjustment may be had, thus adapting the device to hose couplings of various sizes. It is a further object to so construct the clamp that it will have contact with the hose throughout its entire inner circumference thus insuring a tight joint between the hose and the coupling member.

FAUCET.—H. A. LINET, 2 New York Ave., Brooklyn, N. Y. An object of this invention is to provide a faucet of simple construction which may be opened by an upward pressure of the hand so that the hand is wet as it opens the faucet. A further object is to provide a faucet which may also be opened continuously for a steady stream of water.

LOCK.—C. LIBERMAN, 1732 Madison Ave., New York, N. Y. This invention has for its object to provide a lock for use on doors, trunks and other articles, and arranged to prevent unauthorized persons from pushing the bolt back out of the locking position by the insertion and manipulation of thin blades, tools oror other implements. The device is simple and not liable to get easily out of order.

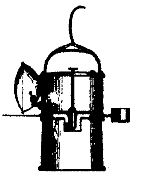
CONCEALED FRENCH CASEMENT LOCK.—C. J. HAGSTROM, 25 Maple Ave., Glen Cove, L. I., N. Y. Among the objects of the invention is to provide a lock for French casement doors or windows, all parts of which are practically concealed even though devices are provided for locking a door or window at both top and bottom as well as intermediate thereof, the part carried by one door being adapted to be operated either by a key or knob, and the parts carried by the other door being adapted to be operated by the insertion of a finger through the striking edge of the latter after the first door is opened.

SHELF PRICE TAG HOLDER.—E. J. COOK, 110 N. Cleveland Ave., Spokane, Wash. The invention has for its object to provide a tag holder formed from sheet metal and capable of being placed on any shelf, and having means for supporting a price tag to indicate the price of goods adjacent to the tag, said tag being adapted to be held by the goods on the shelf.

GASOLINE TORCH.—M. BAYERS, 1004 Simpson St., Bronx, New York, N. Y. This invention relates to portable heating appliances or torches such as are commonly used by plumbers, steam fitters or the like, and has particular reference to gasoline torches with special means for supporting the torch in position upon the tank for use in a manner similar to the use of an ordinary torch, but with adjustability of the torch as to various angles, or for the manipulation of the torch at any desired distance from the tank into places ordinarily inaccessible.

Heating and Lighting

MINER'S LAMP.—E. M. ERICKSON, Box 108, Ray, Arizona. The object of the invention is to provide a simple, strong and efficient miner's lamp, wherein all the parts are made detachable for quick and easy cleaning. The device is composed of upper and lower sections, having a gas-tight joint; a partition is arranged between the water compartment and the carbid compartment, the two being connected by a tube.


A VERTICAL SECTION OF THE LAMP

OIL BURNER.—J. C. EDMUND, c/o Amos Bird Co., Shanghai, China. An object of the invention is to provide means for vaporizing the oil, and a burner lip or tip which permits a free commingling of the vapor and steam to insure a proper burning action. A further object is to provide a burner which is capable of receiving burner tips having different arrangements of grooves and recesses so as to permit of an adjustment in accordance with the fuel oil and steam employed.

Machines and Mechanical Devices

MACHINE GUN.—J. F. O'MALLEY, Box [illegible], Mt. Vernon, N. Y. The object of the invention is to provide a machine gun of the type described in Letters Patent No. 1307816, granted to the same inventor June 7, 1919. The present invention relates to an improved arrangement for supplying the cartridges to the barrel in use at the time from an intermittently revolving magazine wheel instead of from a cartridge belt.

CENTRIFUGAL PUMP.—K. O. [illegible], Nashwank, Minn. This invention has for its object to provide mechanism in connection with centrifugal pumps for permitting the pump to be repaired when it becomes worn without requiring extensive operations on the pump, merely by removing the worn portion and substituting a new portion.

FILM DEVELOPING DEVICE.—F. B. SMITH, 927 Grant Ave., Bronx, N. Y. The invention relates more particularly to a mechanical device for carrying and conducting a film during the developing process. Among the objects is to provide a carrying means which will positively grip the film throughout its travel and hold it in spaced relation from other parts, thus preventing the emulsion side of the film from becoming scratched or otherwise injured, and will eliminate the necessity of having to splice a film in case the same breaks.

FIRE IGNITER.—H. PIERCE, Box 166, Paragould, Ark. An object of the invention is to provide mechanism for igniting fires at a distance. A further object is to provide a trigger operated match lighter which may be placed at the point where the fire is to be lighted and controlled by an operator who may be some distance away. The device is practical and durable, and may be manufactured at a relatively low cost.

GARAGE SHOP MOTOR CRANKING MACHINE.—M. B. WALKER and G. A. MARTIN, c/o La Grange Motor Co., La Grange, N. C. An important object of this invention is to provide an apparatus through which power may be applied to the traction wheels of an automobile to start the engine, especially when the engine bearings are new, or whenever the engine, for any reason, does not start or run smoothly and easily.

CHECK WRITING AND NUMBERING MACHINE.—C. H. WOLFE and H. G. ALLEN, 721 9th Ave., Seattle, Wash. The invention relates particularly to a machine by means of which the amount and number of the check as well as the name of the payor may be filled in in such manner as to successfully defeat erasure or change, the object being to provide a simple apparatus which is readily adjustable, and which will emboss as well as print for the above purpose.

FINISHING MACHINE FOR PILE FABRICS.—T. C. BARKER, c/o Carl C. Maltmann, Jr., Astoria Silk Works, 727 10th Ave., Long Island City, N. Y. The invention relates to cloth finishing and its object is to provide a machine for pile fabrics, such as mohairs and the like, and arranged to insure thorough combing and batting of the pile with a view to remove all extraneous matter and to cause the pile to stand up permanently. Another object is to prevent the formation of streaks, to permit of combing and batting a piece of pile fabric of usual length in a comparatively short time, and to dispense with skilled labor.

COCOANUT HUSKER.—F. N. FONS, C. Del Carmen, B. De Camp, Mexico. The invention pertains more particularly to a manually operated machine for removing the husks of cocoanuts. A further object is to provide means for removing the nut from the husk after the husk has been severed, and means for automatically removing the husk from the machine. A still further object is to adapt the machine for use with nuts of various sizes.

Medical Devices

TONSIL SNARE.—C. R. STORR, P. O. Box 348, Matawan, N. J. The device is intended for use by surgeons in removing the tonsils, its chief object is to simplify the operation of removing the tonsils by an automatic clutch action and loop; this wire loop is tightened by the action of a screw rod whereby the screw rod serves to actuate a slide thus constricting the wire loop until the tonsil is severed thereby.

DENTAL CUSP.—J. HOMER, c/o Thos. A. J. Grady, 704 Parker St., Roxbury, Mass. The invention more particularly relates to cusps for crowns, bridge work and porcelain-faced or other teeth, an object being to provide a cusp

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The Civil War Carved in Granite

(*Continued from page 285*)

recognition by any one versed in the military history of the United States. Each soldier will be fifty feet in height, and will be distinct to the observer five miles away.

The base line of the troops will be two hundred feet from the ground. The main figures will be carved in complete relief and will stand out from the stone. That means that yards and yards of solid granite will have to be slowly and painstakingly cut away to bring them out. The execution of the other figures will be such that some of them will fade into bas-relief and still others into mere sketches, although all are to be full size. The whole effect will be such that it will appear as if the soldiers came out of the mountain, and that, if the mountain were broken up, by some chance, it would be found full of men.

The first seven figures of the army will be a mounted group representing cavalry led by the three men who were probably the most striking characters in the Confederacy: Robert E Lee, "Stonewall" Jackson, and President Jefferson Davis Next will come a troop of cavalry, the vanguard of the army, in close formation, for even in defeat the army of the South, which the cavalry typified, held its spirit high. Trudging masses of infantry will follow, and far over the shoulder of the mountain, seeming to stretch over miles of fields, will come rumbling batteries of artillery.

On top of the mountain there has been installed a hoist from which steel cables will run down the side of the cliff Much rope pulling and attendant danger over the steep sides of the cliff accompanied the installation. This aspect of the work required the labor of fearless men who could stand on brink and balance heavy wooden supports, because the nature of the formation prevented the use of derricks on top.

Much difficulty will accompany the adjustment of transverse cables over the face of the cliff Such cables will be necessary to permit the lowering of the steel cages in which Mr. Borglum and his corps of artists will do their work. Every inch of the face of the mountain will be covered by the cages, so that every part of the rock may be molded to conform with the general picture.

What has added to the task of the laborers is the desire of the sculptor not to have the cages too near the granite, so that there should be no possibility of scraping it, for damage done this natural canvas is well-nigh irreparable. The wooden structure at the brink, therefore, had to overhang the mountain by several feet. In driving the stakes to keep this structure—a stairway affair—in place, care had to be taken to damage the rock only in such a way that repair could be made without leaving inharmonious gashes after the completion of the task

At the base of the mountain, a Memorial Hall will be carved out of solid rock. This hall will contain a chamber for each state of the old Confederacy for the preservation of records, a museum in which relics of the fast-fading reminders of the struggle may be exhibited, and for similar purposes. The hall will have corridors and massive bronze doors. Everything will be on a scale to compare with the huge army on the side of the mountain. The hall and its superstructure will rival the Washington Monument as the biggest stone spectacle in the country, but the Washington Monument, of course, is an architectural triumph rather than a sculptural one.

About three thousand acres of land around the mountain, now wooded for the most part, will be acquired for park purposes; that is, more than 4 square miles of territory will set the army off from the rest of the landscape. Beautiful drives will be laid out, and a lake will be created. Plans are already being made for several memorial gates.

Some Special Uses of Redwood

(*Continued from page 286*)

the Mare Island Navy Yard. For industrial plant flooring purposes, redwood blocks are usually dipped in hot asphaltum before laying, and grouted after laying. For mercantile establishments, offices, schools and other structures, the blocks are laid plain, with tight joints, the blocks glued together and sanded perfectly smooth, and the surface stained or varnished.

Redwood blocks, when used for street paving, are dipped in boiling asphaltum cement, which permeates into the wood fiber about a quarter of an inch. The process serves to seal the blocks against moisture, rendering them antiseptic, and of cementing together the end fibers of the wood, which become tough and exceedingly resistant to traffic abrasion. The blocks are laid rather loosely, with interstices sufficient to admit of free inflow of hot asphaltum cement, which is applied immediately after block-laying This cements the blocks together into a solid structure, and also covers the surface with a heavy paint coat of asphaltum which absorbs the sand coating spread immediately after grouting. The wooden blocks provide a firm foundation for the thin skin of asphaltum on top, and as this is worn away it is easily and cheaply renewed

Redwood makes a superior stave for pipe. There are many stave pipe lines in operation today that have been in continuous service for 30 years or more, and that show no appreciable depreciation The original installations made in 1880 are still in practically as good condition as when installed, and it is estimated that the average life of a well-built continuous stave redwood pipe is from 60 to 75 years.

Rails and Railroads

(*Continued from page 287*)

in a wide variety of fields too numerous to mention in this article.

The various striking uses of discarded steel rails are depicted in our drawing on the opening page of this issue, together with the most striking figures of the magnitude of our track relaying industry.

In short, it is next to impossible to compass the well-nigh innumerable ways in which the material from old rails can be put to use by reshaping it Because our trunk lines insist upon sound steel of a high grade in the first place therefore the rerolling mills get better basic material from the discarded rails than they would be able to buy at the same price new from the steel plants. Thus, thanks to the enterprise of the dealer in secondary metals, old rails continue to be of value long after they have ceased to be fit to hold a position in any of the tracks of our trunk lines, and most of us are the beneficiaries of this conservation either directly or indirectly. Millions of dollars yearly are saved by this procedure, and requirements are met and wants are supplied that it would otherwise be difficult to satisfy.

Two Hundred Thousand Photographs Per Minute

(*Continued from page 288*)

fast an exposure will the chemical sensitiveness of the film stand?" It is possible to make a picture, with modern film, in the 1/2000 part of a second. As a matter of fact, it is possible to make pictures in the 1/3500 part of a second, which means 3,500 pictures per second or 210,000 pictures per minute.

The Jenkins projector has *no* shutter. The ring prism operates in front of the film, behind the lens. The picture is impressed upon the film during the move-

(*Continued on page 299*)

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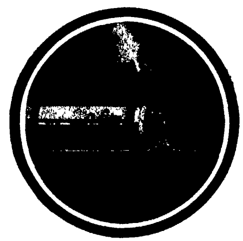

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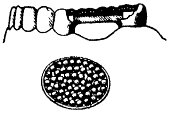
PTL 2 21

RECENTLY PATENTED INVENTIONS

(Continued from page 296)

in which relatively small spherical metal particles, such as "Boston Balls," known as "B B.'s" are employed said balls being secured



A PLAN VIEW, AND INVENTION AS APPLIED TO BRIDGE WORK

in the cusp of the teeth or crown and preferably located under the metal of the crown so as to provide a bearing which can readily be shaped to the proper cusp of masticating surface, thus reducing to a minimum the labor of properly shaping the outer portion of the crown

Musical Devices

REPRODUCER FOR TALKING MACHINES —J. W. KAUFMANN, 1730 N Monroe St, Baltimore, Md It is a purpose of this invention to provide a reproducer in which the resilient member between the needle and the diaphragm is mounted to materially increase its responsiveness to the vibrations of the needle and to amplify such vibrations by allowing the use of resilient members of greater rigidity The device can be used on records having vertical undulations as well as those formed with horizontal undulations.

Prime Movers and Their Accessories

SPRAY NOZZLE FOR VERTICAL DIESEL ENGINES —D. O BARRETT, Chapman Flats 46½ W High St, Springfield, Ohio This invention has for an object to provide a construction wherein the oil may be sprayed into the engine under any desired pressure without placing the main supply of oil under any appreciable pressure A further object is to provide a nozzle for Diesel engines in which means are provided for supplying a measured quantity of oil to the engine at intervals, same being mixed with air at a comparatively high pressure

INTERNAL COMBUSTION ENGINE —O G ERICKSON, 1220 Majestic Bldg, Detroit, Mich This invention has for its object to provide a two cycle internal combustion engine, embodying the combination of piston structure and by-pass arrangement whereby the fresh gas is initially compressed and becomes the agent whereby the gas of the previously burnt charge is expelled A further object is to provide an engine having a dual arrangement of intake and exhaust valves, by use of which the gas is enabled to pass with greater facility

Railways and Their Accessories

RAIL JOINT G J MURPHY, Baradero, F.C C A, Buenos Aires, Argentina The general object of the invention is to provide joint elements to insure the free expansion and contraction of the rails under changes of temperature, and the maintaining automatically of the joint bolts at right angles to the rails without straining the bolts, and to prevent jars or shocks as the car passes over the joint

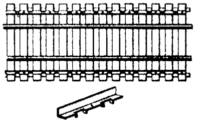
MINE TROLLEY —R G WILSON, Davis, W Va The invention relates generally to trolley pole supports and more particularly to mine trolleys The object is to provide a rapidly reversible pole by longitudinally sliding the same, and which need not be rotated for this purpose, and which is capable of ready release adjustment and resetting with the minimum loss of time

INTERLINE TICKET GUIDE —O S PAYSANT, c/o Alfred Fullheimer, 7 E 42nd St, New York, N Y This inventor has been granted two patents of a similar nature, the general objects being to provide holding members or guides for ticket cabinets of railways and the like, and to provide a construction which can be used with any size ticket and hold the same in proper position so that only one ticket can be removed at a time Another object is to provide a cabinet and guide for either cardboard tickets or folded tickets, wherein the tickets are held in proper place, but are capable of bending regardless of their thickness or number of folds A still further object is to provide a cabinet which is applicable for use with any quantity of tickets.

SWITCH STAND —F A CANTWELL, Frankfort, Kan An object of the invention is to provide a switch stand which is simple and of durable construction in which the signaling means or target is in position to indicate danger at all times, except when the operating parts of the switch stand are locked in position to maintain the switch points set for main line

SWITCH OPERATING AND LOCKING DEVICE —J L BEIL, 302 Main St, Galena, Ill. This invention has for its object to provide a positive locking device which will hold the switch points in position against the rails when operated in an ordinary manner, and which will not allow the switch point to rebound from the rail when thrown too forcibly against same, nor allow the switch to open by a backward movement of the throw bar before the switch is completely closed, thus creating a condition liable to cause wrecks.

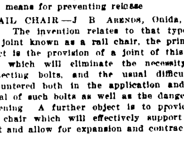
GUARD RAIL FOR RAILWAY BRIDGE — W H ELLIS, c/o Supt B. & B. Dept N. P. Railway, Cheyenne, Wyo A particular purpose of the invention is to provide a simple and inexpensive guard rail which effectively secures the deck ties in proper spaced relation on the girders, and which permits removal and replacing thereof when substituting new ties without detriment to the guard rails



A TOP PLAN VIEW OF BRIDGE WITH GUARD RAIL APPLIED AND DETAIL

CRANK ASSEMBLY —J L BEIL and W. J. O'NEILL, address J L Beil, 302 Main St, Galena, Ill An object of the invention is to provide a crank assembly for ground connections for interlocking movements, as for instance, in railway switch apparatus, having means for preventing play between the moving parts while permitting free functional operation thereof, whereby the length of service is greatly extended

RAILWAY JOINT LOCK —W M. READ, Aitkin, Minn An object of the invention is to provide fish plates adapted to be arranged on opposite sides of the rails at the joints, each plate having a portion which extends inwardly beneath the rail to near the center, and has at each end a downward extension for engaging the tie to prevent longitudinal movement of the plate and wherein means of connecting the fish plates is provided, together with means for preventing release



A PERSPECTIVE VIEW OF THE JOINT

RAIL CHAIR —J B ARENDS, Onida, So. Dak The invention relates to that type of rail joint known as a rail chair, the primary object is the provision of a joint of this nature which will eliminate the necessity of connecting bolts, and the usual difficulties encountered both in the application and removal of such bolts as well as the danger of loosening A further object is to provide a rail chair which will effectively support the joint and allow for expansion and contraction

Pertaining to Recreation

PLANCHETTE —N E GOLDBERG, 22 E 89th St, New York, N. Y The invention relates to games and toys and its object is to provide a planchette arranged to enable two persons seated opposite each other to simultaneously manipulate a movable table without the persons being able to look at each other, thus heightening the effect when using the planchette for answering the questions

AMUSEMENT DEVICE —F E GUILD, 3212 Aner Ave, Milwaukee, Wis This invention has for its object to provide a device wherein a series of cars is provided, and a trackway upon which the cars have guided movement in an endless loop, and wherein a variety of movements is imparted to the car during its passage, the trackway having at each end a turntable to which the cars are automatically connected and disconnected in their passage.

AMUSEMENT APPARATUS —F R CHESTER, 1109 N Warmasser Drive, Asbury Park, N J. The invention relates to amusement apparatus of the racing type. The object is to provide an apparatus for use in pleasure resorts and other places of amusement, and arranged to afford the players and the onlookers considerable amusement and to require skill on the part of the players to successfully play the game in a short time.

PUZZLE —M PEAK, c/o A T & S. F. Ry Offices, Newton, Kan. The purpose of the invention is to provide a puzzle in which a pair of pens or enclosures are provided made up of a plurality of arcuate flanges arranged to provide a plurality of circular channels communicating with each other at different points so as to render it extremely difficult to manipulate the board to direct spheres from the pen into a central pen or goal interposed between the two pens.

Pertaining to Vehicles

AUTOMOBILE.—F. O MACKEY, Box 1402, El Paso, Texas. This invention has for its object to provide means in connection with automobiles, for providing mechanism which may be extended to form a tent bed, or folded into small compass, and wherein the folding bed may be utilized to store camp equipment when not used as a bed The device is intended for use as an extension to the rear of the car.

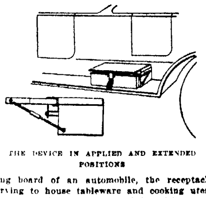
ANTISLIPPING DEVICE —J. D ROSS, 815 10th St., N W, Washington, D. C The object of this invention is to provide a non-skid chain which is of extremely simple and durable construction and highly effective in operation to maintain the requisite degree of traction between the wheels of the vehicle and the roadway, and which is effective at all times to prevent slipping or other undesirable motion of the wheels and vehicle

TIRE CLEANING APPARATUS.—H. G. BALLOU, 737 S Westlake Ave., Los Angeles, Cal The particular object of the invention is to provide a machine for cleaning both the interior and exterior surfaces of casings of tires of the pneumatic type A further object is to provide a machine which is automatic in its operation by means of which the brush in addition to its rotary cleaning motion may be given a vibratory motion to facilitate the removal of the residue of the cleaning operation.

DEMOUNTABLE RIM —J. SIEVEN, 151 4th Ave., Brooklyn, N Y. This invention more specifically has relation to separable or knockdown rims of the demountable class for pneumatic tires used on motor car wheels. The invention provides a demountable rim built in separable sections having positive locking means for holding the sections together, the arrangement being such as will enable the rapid removal or fitting up of a tire on the rim

TIRE.—R W WOOD, Richwood, Ohio. An object of the invention is to provide within the ordinary shoe an expansible element sustaining to shoe in extended formation, and provide in the shoe a contractile element for clamping the shoe around the rim A further object is to provide a tire which dispenses with the necessity for an inner inflated tube which causes the shoe to flatten when the tube is punctured or there is a blow-out

COMBINED RECEPTACLE AND TABLE — H HARRILD, 730 So Maple St, Spokane, Wash A purpose of this invention is the provision of a combined receptacle and table which is adapted to be secured to the running board of an automobile, the receptacle serving to house tableware and cooking utensils, the table when in extended position serving the purpose of a dining table



THE DEVICE IN APPLIED AND EXTENDED POSITIONS

VEHICLE BODY SUSPENSION.—W. D. HAMLER, 7 Water St., Room 309, Boston, Mass. An object of this invention is to provide a construction and arrangement of parts which will permit a limited swing in all directions of the body on its supporting chassis. A further object is to provide means connecting the body and the chassis which will take up shocks and jars and prevent transmission of the same to the body.

AUTOMOBILE SIGNAL CASING.—S. GOLDSTEIN, 10 Stuyvesant St., New York, N. Y. The general object of the invention is to provide a signal for motor-driven vehicles, and more particularly with respect to the convenience with which access may be had to parts for examination, repair, or removal, and to provide a signal that will be visible to those approaching at an angle as well as those directly in front or in the rear, the signals indicating that the vehicle is either about to turn or will stop.

DUMPING CAR LATCH.—A. M. FARRIER, 80 Church St., New York, N. Y. This invention relates more particularly to means for holding the car body in an upright position or locking the same in a full dumping or partially tilted position. A further object is to provide a latch which is automatically thrown by the car body as the latter moves to full dumping position to secure the car body in this position until manually released.

MANUAL CONTROLLING MEANS FOR VEHICLE SIGNALS.—E. G. BALCH, Elm St, Salisbury, Mass Among the objects of the invention is to provide hand-operated setting and controlling means for signals, and it has particular reference to variable or changeable signal appliances for use in connection in, upon, or with vehicles such as automobiles, airplanes, or other land or water conveyances.

MICA LIGHT FRAME —J. T DENNIS, 307 Adams Ave, E. Detroit, Mich. The invention relates to frames for mica lights suitable for use with automobile curtains and similar fabrics An object is to provide a metal frame which can be quickly and easily applied to an automobile curtain and which can be readily detached in order to permit replacement of a broken light.

DIRIGIBLE SPOT LIGHT.—N. GRINWIS, New Era, Mich. A purpose of the invention is to provide mechanism by means of which the spot light of a motor vehicle is rendered dirigible to allow of its adjustment so that its rays may be projected to any desired point A further object is to provide mechanism which can be operated from a point interiorly of an automobile, thus rendering it applicable to closed cars.

ENDLESS RUNNER WHEEL. — J. H KNAGGS, 319 Garden Ave., Coeur D'Alene, Idaho The invntion relates to a tread belt for endless runner wheels comprising a series of linked plates, with flexible members on the inner faces of the plates, bearings secured to the plates and clamping the flexible members between the bearings and the plates, and axles provided at their ends with flanged wheels journaled in the bearings.

WHEEL AND PULLEY REMOVER.—O. W KELLEN, Fairbanks, Alaska The invention has for an object the provision of a construction whereby a wrench or other small instrument may be used to quickly remove a wheel. Another object is to provide a removable device for wheels, keyed or otherwise locked, to live axles or shafts which latter is carried with the wheel and will permit the proper operation for removing the wheel at any time

Designs

DESIGN FOR A CHALK SHARPENER.— J. P. PHILLIPS and N. C AHL, 1537 N. Dover St., Philadelphia, Pa

DESIGN FOR A PENNANT —MILLIE W. HILLGARDNER, 85 Shellbank Place, Rockville Center, L. I., N. Y.

DESIGN FOR A DOLL —RUTH H. USHER, 44 Hanson Place, Brooklyn, N. Y.

DESIGN FOR A HANDBAG FRAME.—J. FISCHER, address Marcus T. Goldsmith, c/o C. I Mfg. Co, 23 Marshall St, Newark, N. J. The inventor has been granted two patents for ornamental designs for handbags.

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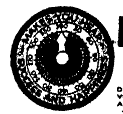

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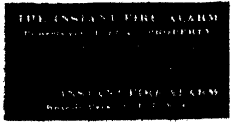


Two Hundred Thousand Photographs Per Minute

(*Continued from page 297*)

ment of one whole prism. At the end of such movement the light ray is shifted back to the top of the frame, as the first bit of the new and unexposed film comes into the frame The "shutter" in the Jenkins camera is simply the passing of the joint between the two ends of the "bar" prism, curved into the circular form

Because of the simplicity of the mechanism, mechanical troubles in both camera and projector are at a minimum The *mechanism is simply a toothed* sprocket to move the film, the usual take-up spool, and multiple-prism glass ring revolved synchronously with the movement of the film and the lens Framing is accomplished by relative rotational advance of the sprocket ahead of the film. In practice a revolving slotted diaphragm works with the glass plate which bears on its edge the ground prism, in order to give the customary sharp edge to the picture.

Mr. Jenkins has made his ring prisms in two forms—one, described, in which the prism is on the edge of a plate of glass revolving across the field of light, and another, in which the prism is ground on the outer edge of a ring, with its axes approximately parallel to the theoretical axis of the circle This circular ring of glass must be slightly tilted in use in order that the lens, which is in the center of the ring, does not pass the rays it receives through the ring again before they reach the screen Curiously enough these two forms, though exactly alike in principle, do not give identical results, the ring form producing pictures less perfect than the plate form

The British Fleet of Today

(*Continued from page 290*)

eign stations were allocated light cruiser squadrons, and, in the case of China, a flotilla of submarines It was soon recognized, however, that this program, modest as it was by comparison with that of pre war days, would have to be modified in deference to the urgent need of economy The Home Fleet was the first to go After being in commission only six months it was reduced on October 1, 1919, to a reserve basis, and a month later was abolished altogether Shortly afterward the "Flying Squadron" of aircraft carriers *was disbanded, all but one of its ships* being paid off On the other hand, a light cruiser squadron and a destroyer flotilla originally embodied in the Home Fleet were transferred to the Atlantic Fleet, which therefore has two light cruiser squadrons and four destroyer flotillas In February, 1921, the battleship "Royal Sovereign" was paid off, its withdrawal leaving the Atlantic Fleet with only nine battleships in full commission During the whole of *last year* the Battle Cruiser Squadron consisted of only the "Hood" and the "Tiger," the "Renown" being absent in Australia with the Prince of Wales and the "Repulse" undergoing a large refit The "Repulse" has now been recommissioned, but the "Renown" has been placed in reserve, so that the present strength of the squadron is limited to three ships

Although nominally in full commission the Atlantic Fleet today is not, in fact, on a footing of immediate readiness for active service. A substantial proportion of the ships' complements is made up of boys and young, untrained seamen. Naval officers have recently complained that so much time is taken up with training the personnel that few opportunities are left for evolutionary and tactical exercises Moreover, in view of the unsettled political conditions in Europe and the Near East, it is useless to map out a training program for any length of time, as ships are liable to be detached at short notice for active service in one or other of the disturbed areas. For the greater part of last year the First Battle Squadron of the Atlantic Fleet was detained in the Mediterranean owing to the menacing attitude of the Turkish Nationalists, and during the same period it was necessary to station a squadron of light cruisers in the Baltic in order to keep an eye on the Bolshevist *forces So far, at all events,* the return of peace has brought no rest for the British Navy

The Reserve Fleet makes a most imposing showing—*on paper* Every naval port is congested with ships, nominally "in reserve," but actually with skeleton crews on board Ships which scarcely more than two years ago were the pride of the Grand Fleet now swing idly at their moorings, all but deserted Beatty's famous flagship, the "Lion," *now* has *only* three wardroom officers on board, and others hardly less celebrated are in charge of "care and maintenance parties," which means a handful of men just sufficient to keep the machinery from rusting At Sheerness, Portsmouth, and Devonport one may see long lines of destroyers, some launched as recently as 1918, apparently untended and waiting passively for the word that will send them to the shipbreaker

The actual strength of the British Navy in commissioned ships on the various stations in March, 1921, may be summarized as follows

Home Station Battleships—"Queen Elizabeth," "Royal Oak," "Resolution," "Ramillies," "Revenge," "Barham," "Valiant," "Warspite," "Malaya Battle-cruisers—"Hood," "Tiger," "Repulse" Light cruisers—"Delhi," "Danae," "Dauntless," "Dragon," "Dunedin," "Caledon" "Carysfort," "Castor," "Cleopatra," "Cordelia" Destroyers—four flotillas, with a total of 72 boats, and the light cruiser "Coventry" as flagship of Rear Admiral (D) Submarines Three flotillas, with a total of 21 boats Miscellaneous ships—One aircraft carrier, one minelayer, eight depot ships

Mediterranean Station Battleships—"Iron Duke," "Emperor of India," "Ajax," "Benbow," "Centurion," "King George V" Light cruisers—"Cardiff," "Calypso," "Caradoc," "Centaur," "Ceres," "Concord" Destroyers—One flotilla with a total of 23 boats (including 3 with reduced complements) Miscellaneous ships—One aircraft carrier, seven sloops and gunboats (for service on Danube and in Red Sea), two surveying ships

Gibraltar Local defense flotilla, consisting of four destroyers

East Indies Station Light cruisers—"Highflyer," "Caroline," "Comus" Miscellaneous—Three sloops and an armed yacht The flagship "Highflyer" is a very old cruiser, launched more than 20 years ago, and was recommissioned only because she is a healthy and comfortable ship in tropical climates Her fighting value is negligible

Africa Station Light cruisers—"Birmingham," "Dublin," "Lowestoft" Miscellaneous—Two *gunboats and a depot ship*

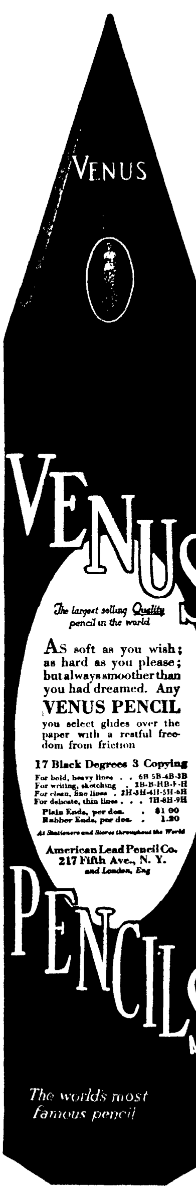
China Station Light cruisers—"Hawkins," "Carlisle" "Colombo," "Cairo," "Curlew" Submarines—One flotilla consisting of 12 boats of the "L" class (of which 4 have no crews) Miscellaneous—21 gunboats and sloops, 4 depot ships

North America and West Indies Station Light cruisers—"Calcutta," "Constance" Miscellaneous—2 sloops The new cruiser "Raleigh," now being completed, will shortly proceed to this station as a flagship, and it is expected that one of the three ships named will then be sent home

South America Station Light cruisers—"Southampton," "Dartmouth," "Weymouth" Miscellaneous—1 sloop

New Zealand Light cruiser "Chatham" and 1 sloop

Australia The only vessels of the Royal Australian Navy now in full commission are two light cruisers, six destroyers, six submarines, and several sloops The battle-cruiser "Australia," 4 light cruisers, and six destroyers have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Canada All vessels of the Royal Canadian Navy have been paid off with the exception of the light cruiser "Aurora" and two destroyers, which at present are in the Pacific based on Esquimault

In June of this year a conference is to be held in London between the Premiers of the Dominions and representatives of the British Government, at which the whole question of future naval policy is to be threshed out It is possible that, as a result of this meeting, the distribution of British naval forces on the foreign stations may be modified, but whether in the direction of increased or reduced strength cannot be forecast If, as is anticipated, further economies in the naval budget are deemed to be necessary, the number of commissioned ships in home waters will be reduced At the moment of writing it is considered probable that the Atlantic Fleet will be cut down to eight battleships, with corresponding reductions in the quota of light cruisers, destroyers and submarines

The Current Scientific American Monthly

(Continued from page 291)

sounds His study was initiated by the attempt to produce a pipe organ which would give vowel sounds thereby assisting the choir and the congregation when singing The article brings out many novel ideas for instance, it shows that it is not particularly with relation to the form of the mouth but the larynx that distinguishes a Caruso from a costermonger

Among the lighter articles is one on the manufacture of billiard balls, which should be of particular interest at the present time In the field of natural history will be found a very interesting article on hornets and other useful wasps This describes the nest building and community life among these busy insects

In addition to twenty-two leading articles and a large number of short articles and notes the current MONTHLY contains the usual departments devoted to scientific research and progress in the various fields of technology

NEW BOOKS, ETC.

PLATINUM AND ALLIED METALS IN 1919. By James M Hill Washington Government Printing Office, 1920 Paper 8vo, 10 pp

A Geological Survey report on the metals of the platinum group with comparative statistics of production, trade and consumption, stocks on hand Dec 31, market and prices, and notes on home and foreign deposits and production

WINGS OF WAR By Theodore Macfarlane Knappen New York G P Putnam's Sons 1920 8vo, 289 pp, 44 illustrations

There was a time when it seemed to us anxious outsiders that our ambitiously planned aerial war fleet would 'go up in smoke' that was not the smoke of the battlefield, and the Liberty engine seemed as near perfection as the perpetual motion device In "Wings of War" while mistakes and delay are by no means minimized, we have the thrilling story of how, from nothing, was built up a huge industry turning out 1,600 planes a month The history and final triumph of the Liberty motor is told and we find that, after all, our production of aircraft and equipment ranks as one of the most wonderful achievements of the war All can understand and enjoy the book, and the student and technician will find in it much to reflect upon

A CLASSICAL TECHNOLOGY Edited from Codex Lucensis, 490 By John M Burnam Boston Richard G Badger, 1920 8vo, 170 pp

This transcription from an ancient Ms holds great interest for the antiquary It is followed by a careful translation and is further made intelligible by a glossary and pertinent notes. The subject matter consists of old recipes for colors, inks, varnishes, welds, cements, alloys and compounds

MACRAE'S BLUE BOOK, 1920 New York and Chicago MacRae's Blue Book Company 4to; 1838 pp

The steady growth in bulk and in popularity of this buying guide is convincing testimony to its completeness and the convenience of its arrangement The Address Section gives, alphabetically, 30,000 American manufacturers, with locations of branch offices and representatives the Classified Material Section lists under 10,000 classifications the sources of supply for railway, iron and steel, building and other products a Trade Name Index occupies a hundred pages a Miscellaneous Data Section is for the benefit of all who specify or purchase and this is followed by standard list prices of products, supplemented by tables for the instantaneous computation of discounts. Look for the noun is the slogan, and by listing such double named items as "Water coolers" under the noun "Coolers," much space has been saved for the book, and much time for the consultant

FUEL BRIQUETTING IN 1919 By F G Tryon Washington Government Printing Office, 1920 Paper 8vo; 4 pp.; 1 illustration

Production, value, raw materials, and number and location of plants are given in this Government bulletin

COAL IRON AND WAR By Edwin C. Eckel. New York Henry Holt and Company, 1920 8vo 375 pp 9 graphs

One thing alone would make significant this contribution of a geologist and engineer It recognizes the fact that industrial development is largely a phase of purely natural evolution" This recognition means a viewpoint more impartial than is customary The facts, the material bases, and the causes and effects of industrial growth are impressively set forth, and the future of industrialism is discussed with insight Those who believe the common weal is best promoted by methods neither too reactionary nor too radical will warmly endorse the ideas and conclusions here advanced

A COURSE IN ELECTRICAL ENGINEERING. Vol I Direct Currents By Chester L Dawes, S B New York McGraw-Hill Book Company, 1920 8vo, 496 pp, illustrated

Beginning with the simplest conceptions of magnetism and current-flow the text proceeds to describe and explain batteries instruments and measurements the generator, the motor, and the transmission and distribution of power The work was undertaken in response to a demand for a plainly phrased comprehensive text covering the general field of electrical engineering Figures and cuts problems, questions and tabulations appear in abundance, and the student taking a course in this subject as a part of general training will find the exposition well within his capacity and understanding

THE NATION'S FOOD By Raymond Pearl, Ph D, Sc D, LL D Philadelphia and London W B Saunders Company, 1920 8vo, 274 pp, illustrated

The need for better information on resources and consumption was made painfully evident to the author when he was Chief of the Statistical Division of the Food Administration Finally the Division succeeded in acquiring a mass of the most valuable facts which, properly tabulated and arranged, are now available to all in this broad study of a paramount problem No attempt has been made to interpret these facts' the author, to use his own words is a hodcarrier delivering an abundance of carefully made bricks to the specialist, who may build from them the structure he needs It is a thorough survey of food resources on a nutrient basis, the investigation keeps the nutrient factor well to the fore This manner of presentation elevates the service far above "hod-carrying," essential as that may be

CHEMICAL ENGINEERING CATALOG 1920 Edition New York: The Chemical Catalog Company, Inc 4to, 1,450 pp.; illustrated

Almost every branch of industry has come to rely upon chemistry for important materials tests, or processes, accessible information as to sources of supply has become an imperative need, and the popularity of this catalog, and its growth since 1916, demonstrate that its well-defined field of service has been intensively cultivated Under the auspices of the leading chemical societies, it dispenses exact, full knowledge of the manufacturers of equipment and supplies, furnishes a classified directory of their products, supplements this by an information bureau, and, this year, offers a greatly enlarged list of more than a thousand technical books in English, with subject index. The condensation, standardization and cross-indexing show meticulous care and excellent results; all who use, buy, or specify raw materials, machinery or equipment for chemical processes of manufacture will find the information official and of inestimable benefit.

THE FUNDAMENTALS OF PHOTOGRAPHY By C. E. K. Mees, D.Sc. Rochester, N. Y.: Eastman Kodak Company, 1920 8vo.; 111 pp.; illustrated.

There is a natural curiosity in the mind of the beginner to know just what happens in the camera and the dark room to produce the finished picture Repelled by the difficulty of finding the optical and chemical facts clearly and briefly expressed, that curiosity too often dies. Dr Mees has come to the rescue with a lucid, pictorial account of actions and reactions, whys and wherefores, that not only makes theory plain, but also contributes to practical success

HANDBOOK OF COMMERCIAL GEOGRAPHY By Geo G Chisholm, M.A, B.Sc. New York and London: Longmans, Green and Co, 1920. 8vo; 666 pp.; illustrated

The eight additions through which this work has traveled into the favor of educators witness its excellence. It recognizes intellectual interest as tending to material success in business, and imparts such interest to the facts in which it deals, high school and college will appreciate the new zest given to the lesson Connected thought is thought retained; hence alkali for example, is considered in its trade relationships to salt, sulphur, lead etc. Commodities also appear under climatic groupings while the maps show density of population products and chief exports The work is of British origin, but its value to our students of trade is no less than to their cousins across the sea

BLUE PRINT READING. By E M Wyatt Milwaukee: The Bruce Publishing Company, 1920 8vo; 86 pp., 29 plates

Mechanical drawing is treated as a universal language, with rules of grammar to be observed in writing and interpreting it. The course offers, not an expert understanding of drawing, but a working knowledge of fundamentals, conventions, shop sketching, and particularly of the interpretation of the working drawing. Detailed study of a set of house plans and of a bench grinder conclude the brief, helpful lessons.

THE ELEMENTS OF MARKETING By Paul T Cherington New York: The Macmillan Company, 1920. 8vo; 238 pp, illustrated.

If the student has a fair grasp of economic principles he should find no difficulty in mastering this course, which is confined to the practical problems of merchandise distribution Marketing functions—assembling grading storing, and transporting—are discussed constructively financing, risks and sales in their relations to equipment, personnel, and the public are studied, and there are chapters on the components of a retail price and the costs of distribution It is a well rounded presentation by a thoroughly qualified instructor that goes to the gist of the matter in a welcome manner.

THE SYSTEM OF ANIMATE NATURE By J Arthur Thomson, M.A., LL.D New York: Henry Holt and Company, 1920 2 volumes: 8vo.; 687 pp

A new book by this distinguished naturalist is an event worth celebrating, and there is no better way of celebrating it than by partaking of the banquet he has himself provided All animate nature has been canvassed to provide this feast, and scientist and layman may sit together at the board and take their enjoyment. The pessimistic conclusions of the past century are shown to be largely the result of malassimilation of facts; under the author's logical manipulation, the subtler phenomena of nature take on new significance All who are interested in biological and psychological evolution may read and understand this luminous story of man, his place in the universe, and his hope for the future. It is philosophy at its best, with its feet on *terra firma* and its gaze courageous, keen and sane

THE AMERICANIZATION OF EDWARD BOK. An Autobiography. New York: Charles Scribner's Sons, 1920. 8vo.; 461 pp; illustrated.

At the age of six, a poor Dutch boy was brought to this Promised Land. His arduous efforts to help his parents might easily have resulted in intellectual stultification, but the Bok boy had ideals. He forged ahead, developed his mind, caught and kept a broad view of life, and finally became editor of *The Ladies' Home Journal*, making it an instrument of educational value in the home. His life has brought him in contact with six of our presidents; with Emerson, Longfellow, Stevenson, Kipling, and other noted authors; and with such celebrities as Jay Gould, Henry Ward Beecher, and Gladstone. It is one of the autobiographies that old and young may delight in and profit by.

SCIENTIFIC AMERICAN

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30 MAY 1921

IN THIS ISSUE:

Germany's Brown Coal
Finding Jobs for Radium
Taking the Roll Out of Ships
The [illegible] and the [illegible]
[illegible] Mushrooms

CONVERTING THE IDLE AUTOMOBILE INTO A FARM TRACTOR.—[See page 313]

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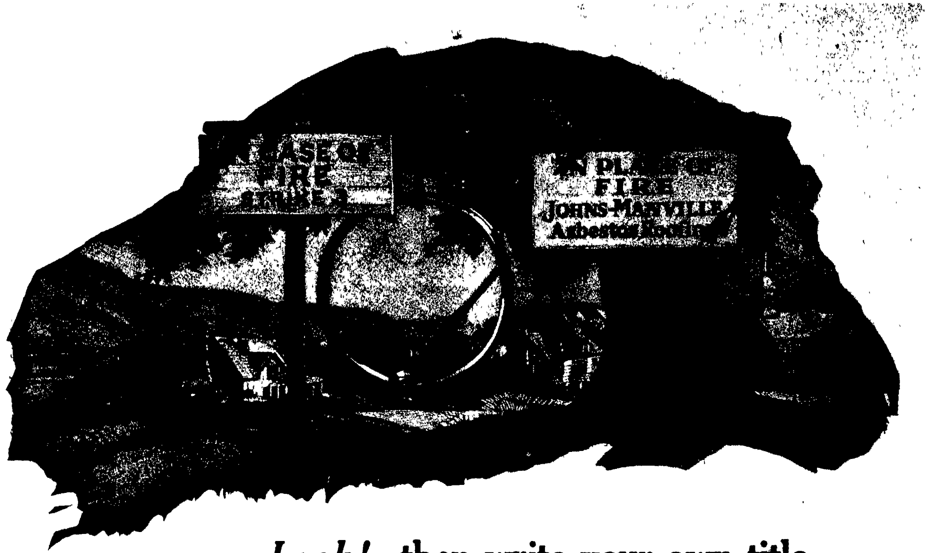

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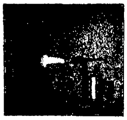

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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIV.
NUMBER 16

NEW YORK, APRIL 16, 1921

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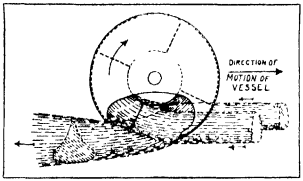
A New Form of Hydraulic Propulsion

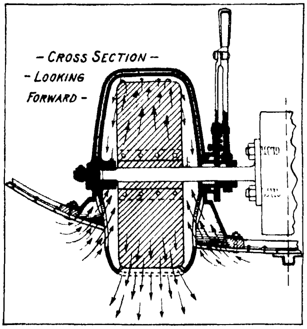
SO far as the records go, it is well established that the idea of propelling a vessel by means of a rearwardly discharged jet of water is very old Indeed we are told that the first definite proposal of this kind was made by John Allen in 1729 The required stream of water was obtained by means of an early engine of the Savery type. In 1866 the British Admiralty equipped the "Waterwitch," of 1,160 tons, with a hydraulic propulsion system, patented by John Ruthven The results were discouraging. Then, in 1881, Sir John Thornycroft developed Ruthven's plan in a small torpedo boat of 14½ tons, securing a speed of only 12.6 knots, as compared with 17.3 knots obtained by a similar boat driven by a propeller During the war it was realized that hydraulic propulsion, because of its comparative silence would be a suitable drive for vessels engaged in submarine hunting Each vessel built for this work was fitted with a pair of centrifugal pumps which drew water from a forwardly pointing tunnel outside the skin of the ship, and discharged it through another tunnel pointing aft

For these facts and for the illustrations which accompany this article we are indebted to *The Engineer*, of London, which gives considerable space to the description of what is known as the Hotchkiss system of hydraulic propulsion so named after the inventor, Mr Donald V. Hotchkiss, Associate Member of the Institute of Naval Architects

Our drawings, which are based on those which appeared in the article referred to, will help to make clear the following description of this interesting experiment The system is shown as fitted in a weldless steam launch which has a draught of one foot five inches, and a displacement of two tons The motor develops eight horsepower at normal load and is coupled through reduction bevel gearing to two Hotchkiss pumps The engines run at 800 revolutions, and the pumps at 270 Each pump delivers a stream of water 24 inches in cross sectional area, at a speed of 15.4 feet per second, the result of the rearward discharge being about 9½ tons per minute This means that in 12½ seconds, the pumps can discharge a weight of water equal to the displacement of the vessel



Principle of the new hydraulic propulsion method



Cross-sectional view of one of the pumps, showing the stream flow

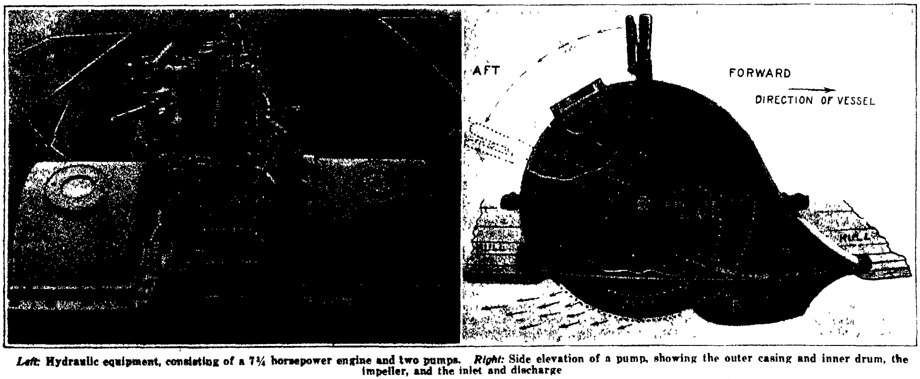
The general principle of the system, as shown in our diagram representing the flow of the water pumps, of which there are two one on each side of the keel consists of a four bladed impeller, which rotates within a cylindrical casing, in the lower part of which are formed three openings, one on each side and one in the periphery In the diagram the strips that separate these holes are shown as having been cut out It will be noted in the cross-section of the pump that the casing is considerably wider than the blades, leaving on each side of the blades a passageway of considerable area In the diagram the boat is moving toward the right, and the impeller is being driven clockwise as shown by the arrow Its rotation creates a vortex within the casing The water is drawn into the casing through the side holes, and once inside the two inflowing streams converge into one, which passing centrally between the two entering streams, is discharged toward the stern of the boat The broadly triangular shape of the discharge stream should be noted

Referring to the cross section of the pump it will be seen that the casing contains an internal drum, mounted upon the impeller shaft, and fitting fairly closely to the casing The drum, in its lower half, extends somewhat below the bottom of the vessel, and it is provided, as noted above, with two side openings and one in the periphery The outer casing completely encloses that part of the inner drum which lies above the center line of the impeller shaft Below this line the outer casing flares to a junction with the skin of the hull to which it is fastened

Referring to the side view it will be noted that the casing in the neighborhood of its forward end is swept forward to form an inflow passageway, *A*, the mouth of which opens just below the outer skin of the hull The under portion, *B*, of this extension is simply a stream lined filler, which fills the space between the outer wall of the passageway and the periphery of the internal drum, and provides for an easy flow of the outside water

In the position shown in the side view, the peripheral opening of the internal drum is completely open to the water, and it forms the orifice through which the stream of water is discharged rearwardly from the impeller The inlet stream of water which enters

(*Continued on page 315*)



Left: **Hydraulic equipment, consisting of a 7¼ horsepower engine and two pumps.** ***Right:*** **Side elevation of a pump, showing the outer casing and inner drum, the impeller, and the inlet and discharge**

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Tidal Power in France

IT is possible to say that, even in an economical sense, *the great war was not all loss*, *for out of* the colossal destruction and soaring costs has grown a demand for a more thorough utilization of certain natural resources which have been hitherto neglected. Before the war the world had become adept in the utilization of the water power of rivers and streams, and present indications are that this source of power is about to be exploited on a scale that has never yet been attempted. Several such developments, indeed, are already under way. An absolutely new source of power, however, is the utilization of the ocean tides—new, not in the sense that the subject has never been talked and written about, and even in a crude way made the subject of experiment, but new in the sense that the problem is now about to be grappled with on a large scale and with all the resources of governmental finance behind it. The biggest of these projects, at the mouth of the River Severn, we have recently illustrated in this journal, and now comes an announcement from France that the French government is about to develop the tidal power at the mouth of the picturesque River Rance, which finds an outlet at the quaint old town and harbor of St. Malo—one of the points of debarkation for our American troops, by the way, which will dwell long in the memory of many of our soldiers and sailors that went to the Great War. The tide at St. Malo has the great rise of thirty feet, and the local topography of the place should be favorable to an economical construction of the necessary dams to impound the water. The system will be of the double flow type—that is to say, the turbines will operate both on the inflowing and the outflowing tide.

Ventilation in Motor Vehicle Tunnels

THE engineers of the New York and New Jersey State Bridge and Tunnel Commission are to be commended for the thoroughness with which they are investigating the question of ventilation in vehicular tunnels. There is nothing new about the construction of this tunnel. It is a straight job of civil engineering, and it will be well done. But the construction of a tunnel of this length to carry a dense automobile traffic is altogether new, and the question of ventilation is absolutely fundamental to its success. The engineers of the tunnel have engaged the Bureau of Mines to investigate and report on the ventilation problem. In a report made last November, the Bureau answered the questions, first, as to the amount and composition of exhaust gases from motor vehicles, and second, the amount of dilution with fresh air necessary to render such gases harmless. The investigation of exhaust gases was made at the experiment station at Pittsburgh on over one hundred automobiles and trucks, the determination of the necessary dilution with air for human consumption was carried out in the Physiological Laboratory at Yale University, when it was found that after the students had been subjected to one hour's exposure to air whose carbon monoxide compound did not exceed four parts in 10,000, no noticeable symptoms of discomfort appeared.

The Bureau of Mines is now engaged in determining the most efficient method for sending the necessary quantities of air through the tunnel. This investigation is to be carried on at the University of Illinois, where an experimental duct 100 yards in length and similar in cross section to the air ducts proposed for the Hudson River tunnel is being constructed. This investigation will supply valuable information on the question of the friction of the flow of air in concrete ducts of various contour. Not alone will the investigation answer the questions which are being asked regarding the Hudson River tunnel, but it will provide data that will be of great use to the mining engineer, who is making increasing use of concrete construction. The Bureau of Mines at Pittsburgh, furthermore, is building an experimental tunnel in which a final and conclusive test will be made, based upon the data already secured. The tunnel, which will be oval in shape, will be built with air ducts similar to those in the Hudson River tunnel. It will extend for a length of 400 feet and the cross section will be large enough to permit a single line of automobiles to run through the tunnel under the usual headway. In this, the final test, it will be possible to determine the diffusion of the exhaust gases, the temperature conditions, as affected by the motors, and the full physiological effects of temperature, exhaust gases, and smoke, under actual operating conditions.

Cutting Down Transportation Costs

THE so-called container type of railroad car, recently illustrated in our columns, has now been sufficiently long in service to enable the New York Central lines to give some definite figures as to the saving effected by this very sensible device. The steel express car, with nine portable containers, has made several successful trips between this city and Chicago with the Twentieth Century and other fast trains. The company is satisfied that the new car will save demurrage, truckage and clerk hire, and will prevent large losses by theft. The system, it will be remembered, provides a compartment service by means of containers which, in effect, provide for shippers the use of individual traveling safe-deposit vaults of various standard sizes. When these containers have been loaded and locked they are carried intact from the door of the sender to the door of the receiver of freight. They are transferred from factory to train and from train to store door of the consignee either by motor truck or electric car. On delivery they are unlocked and unloaded at the convenience of the consignee.

Now the significance of all this is seen when we are told by the railroad people that loss and damage *of freight has grown in recent* years *to one of the* heaviest leaks in transportation, and that for its prevention the railroads have to maintain a police force and carry on educational campaigns among shipping and railroad employees to secure better packing, more careful handling, and the suppression of theft. That all this effort has failed to stop the economic waste *is shown by the fact that in the year 1914* the American railroads paid out in claims for loss and damage of freight 33 million dollars, and that in 1920 this had grown to the stupendous total of 125 million dollars. As the result of the recent tests, the New York Central is of the opinion that the large economies effected by the new lock-safe system of transportation, such as prevention of loss and damage of freight, saving in wages and those due to the cheaper and lighter boxing and crating now possible in the case of individual small shipments, great as they are, will be exceeded in amount by the greater use of moving equipment, railroad cars, trucks, et cetera, due to the new method of shipment. Container cars can be loaded and unloaded in a fraction of the time required for hand truckers to fill or empty a box car of miscellaneous articles at a platform.

The railroads are making heroic efforts, just now, to cut down the cost of transportation. They scored their first success in raising the average load per car by a large percentage, and if, as seems likely, the container car shipment for miscellaneous freight becomes general, we may look for another great reduction in the costs of operation.

The Navy Should Have a Bureau of Aeronautics

THE activities of the Navy Department are carried on under a system of separate bureaus, each of which is confined to certain specific work. Thus, the Bureau of Construction and Repair designs the hulls of the ships; the Bureau of Steam Engineering designs the motive power; the Bureau of Ordnance designs the guns, and so forth; and each of these is in charge of a director, or chief, who directs and is responsible for the work done in his own particular bureau. This segregation of the multiplied activities of the Navy has not been an arbitrary matter; rather, it represents a natural growth in which the institution of separate bureaus has been rendered necessary by the multiplication of inventions and discovery and the ever-increasing complexity of the modern warship. In fact, the bureau system finds its counterpart in that specialization which is such a marked feature of our modern industrial activity, where the growth of each particular branch of industry has been so rapid and has so greatly widened the field of knowledge, that it is all that one man can do to get a thorough mastery of one particular field.

The birth and rapid development of the new art of aeronautics and the important part which it is bound to play in future naval warfare have brought the Navy Department face to face with the question as to whether it must not now create another bureau to deal with what is already a highly specialized branch of naval activity. Even today, when we stand merely on the threshold of aeronautical development, the art is sufficiently developed to call for the services of a highly specialized class of men in the designing room, in the work shop, and in actual flying service with the fleet at sea. What we already possess in the way of machines, men and knowledge is merely a beginning, and it is certain that the call for a special bureau will become more insistent as the years pass by.

There is a powerful movement at work in favor of the institution of a United Air Service, in which the design and construction of machines and the training of officers will be done under a single central body, and the machines and the men allocated to the Army or the Navy in response to the demand. Personally, we believe that the Army service on land and naval service at sea are so widely different, both in the character of the machines required and in the training of the personnel, that no greater mistake could be made than to include the two branches in one central service.

In the first place a machine that is suitable for land service is not suitable for the sea. The conditions are widely different. Given a fairly level and smooth field, the Army plane can take off and land upon it no matter in what part of the world the landing field be situated; but for sea service you must have a plane which can take off from or land upon the sea itself or upon the unstable platform of a ship which has been built especially for that purpose. Furthermore, not only must the naval aircraft be designed for these special conditions, but the flying man, to be thoroughly efficient, must have been bred to the sea. He must have acquired that sea instinct and initiative which is the mark of your efficient naval man and is every whit as essential to the officers and men who navigate in the air as to those who navigate upon the surface of the sea. The air squadrons of a great fleet must be trained to operate with that fleet and find their proper position in it just as completely as a battle-cruiser squadron, a cruiser squadron, or a flotilla of destroyers and submarines. They must know their commander-in-chief, be familiar with his tactics, and be on their toes all the time, ready almost to anticipate the orders which long familiarity and training have taught them to expect.

To put the flying activities of the Navy under a separate outside organization such as the Army or a United Air Service, would be as efficient as to have a United Bureau of Ordnance and have the Navy constructor send the sketch plan of the proposed armament of the ships to such a body, with the request that they design the suitable guns, gun mounts, projectiles, ammunition hoists, and what not. Such a course would make for errors, misunderstandings and inefficiency.

Hitherto the development of naval aircraft has been everybody's task and the task of no one in particular. The immediate need of the Navy is a responsible directing bureau in the Navy which can care for naval aviation and foster its growth and development. Unless we have such a bureau, aviation will continue to stagger along and we shall be faced with a repetition of the failures which have been all too frequent in our submarine development.

The idea of coordination, as expressed in a United Air Service, is attractive as an abstract proposition. Great Britain thought so—tried it out—and has abandoned the idea as impracticable.

Electricity

Equipment for 220,000-Volt Transmission. — There have just been completed for a California electric company a number of transformers and accessories to be used on the world's first 220,000-volt power transmission system. The total weight of each transformer is 50 tons, including oil The height from rail to top of bushing is 24 feet, and the diameter is 10½ feet.

Compressed Air Cleaner for Electrical Machinery.—If compressed air is available, there is no better way to clean electrical equipment such as generators and motors than with a newly-developed cleaner This is a device which is clamped directly to the air hose, and is provided with a quick-acting hand valve that gives complete control. The shape of the cleaner is such that it can reach in otherwise inaccessible places

A New Method of Manufacturing Nitrogenous Compounds has been developed and placed in operation in Sweden. The method, which is an electrochemical process has many points of resemblance with the Haber process, but is said to be more economical and reliable. Heating is effected by electricity, and according to the statements made before an engineering body at Gothenburg, some 22 pounds of combined nitrogen can be made with the consumption of 12 kilowatts

Hydroelectric Development in Italy. — From Commercial Attache H C. MacLean we learn that during the war, in spite of the shortage of labor and the difficulty in obtaining equipment, hydroelectric development in Italy made rapid progress It is estimated that whereas in 1915 Italy's electric power resources amounted to 2,500,000,000 kilowatt hours per annum, this figure had been increased to 3,700,000,000 before the end of the war, and now approximates 4,000,000,000 The capital of Italian electric companies now reaches about 1,500,000,000 lire

Radio Railroad Signals.—A new signaling system making use of radio waves has been developed in Germany. The transmitting apparatus is placed on the locomotive with the loop antenna so suspended from the underside as to cause electric waves to be radiated toward the permanent way. At points of the road where signals are to be given to the train there are tuned circuits made up of loops, the characteristic waves of which are identical with the wave length of the transmitter, continues *Wireless Age* A visual signal within the locomotive cab gives well-defined indications when the track devices are passed

Telephoning Over Lighting Mains.—In a brief note communicated by the technical commission of the French Syndicate of Producers and Distributors of Electrical Energy, a device is described by the aid of which a line between a generating station and a substation may be utilized both for telephone communication between the two stations and for lighting, heating or storage-battery-charging purposes The line is normally connected for power service, continues *Electrical World*, but as soon as the receiver is lifted off the hook on any telephone apparatus on the system the line is disconnected from the power supply by means of relay-operated breakers and connected to the telephone system

Wooden Masts for Radio.—Wooden structures have many advantages over steel, giving as they do a greater effective antenna height and absorbing less power in eddy current losses, according to constructors of such masts They permit the installation of a smaller generating plant, with consequent reduction in capital outlay and annual charges, or, alternatively, the employment of smaller masts to communicate over a given distance These masts are economical to erect as suitable material is usually available near the site When properly erected, they have the greatest stability A large number of the Elwell type masts, from 300 to 714 feet in height, have been erected, and not one has failed

Electric Power from the St. Lawrence. — A plan has recently been brought to the attention of the engineering fraternity, calling for the harnessing of the St Lawrence River in order to develop some 5,000,000 horsepower of electrical energy, and to provide a 30-foot waterway for freight that must be transported between the Great Lakes and the Atlantic Ocean. The proposed development involves the construction of five dams with a generating station at each end of each dam. This arrangement is essential to the handling of the great ice floes of the St. Lawrence The logical dam to construct first would be that at Croil Island, about 33 miles below Lake Ontario, the second would be located near Massena Point, N. Y, about 15 miles downstream from the first; the third would be about 44 miles farther along, near Cedars, Quebec, the fourth about 4½ miles below, near Cascades Point, Quebec, and the fifth about 20 miles downstream, near Côte St. Paul, Quebec. About 40 feet of head would develop at each point, the aggregate being 196 feet.

Science

National Parks Protected from Power Grabs.—Commercial dams and power houses can no longer be constructed in our western national parks The hand of the spoiler has been stayed by Congress

The Equinoctial Storm Has No Basis in Fact.—That the equinoctial storm is a myth is demonstrated by an astute coöperative observer of the U S. Weather Bureau This popular belief is probably the result of early teaching handed down from father to son Old weather saws are very hard to eliminate.

Roger Bacon's Cipher Manuscripts.—A discovery of cipher manuscripts of Roger Bacon show that he was familiar with the use of high-powered microscopes and telescopes. A key to the code was discovered by Dr Newbold of the University of Pennsylvania Many of the results of modern science are said to have been anticipated Fuller particulars will be given to the world shortly

Paris War Library.—Over 100,000 volumes and almost as many pamphlets, etc, have been collected by the French Government and a building will be erected having five miles of shelving The future historian will probably die in the first mile The collection of manuscripts, photographs and war records is appalling as to numbers, and there seems to be no limit to the gifts of collectors In this country Princeton University and the University of California are especially strong on war material.

Americans Like Milk. — The average American is becoming a confirmed milk drinker He consumes twice as much as in former generations The consumption of milk per capita was 44 gallons last year, without counting up dairy products such as butter cheese and ice cream While milk is not very cheap at the present time, owing to the cost of labor, railroad charges and the scarcity of brewer's grains, still the present-day facilities of obtaining milk in prime condition is largely responsible for the increasing use

China Had a Zoo in 11 B.C. — We find that the Chinese were always to the forefront in ancient days when anything scientific is concerned They started a "Zoo" in 11 B C, only they called it an "Intelligence Park" The ancient Greeks and Romans were fond of seeing strange animals, but they do not appear to have collections as such, the gladiators getting most of them The modern zoological gardens had their origin during the middle ages when feudal magnates and royal persons had menageries In the middle of the fifteenth century there were zoological gardens, aviaries and fish ponds in Mexico

Salvarsan Profits for Science.—The sum of $500,000 has been made over to the Dermatological Research Laboratories in Philadelphia by Doctors Schamberg, Kolmer and Raizess, being the profits received by the laboratories during the war from the sale of the drug arsphenamine, a substitute for "salvarsan." Its manufacture was the result of experiments carried out by these noble minded professors Once more American science has won a chemical victory and the domestic article which was so sorely needed was sold for one-third less than the greedy German manufacturers demanded and now even the profits go to science

Free Asphalt in the Gulf of Mexico.—Our asphalted streets are so expensive that the very thought of "free" asphalt even though it is in the Gulf of Mexico is refreshing Along the coast of Texas have been found thousands of tons of fresh asphalt in floes like ice and of varying thickness The phenomenon of asphalt appearing in the beach surf revives stories told many years ago by coast residents of similar occurrences, long before the discovery of the Tampico oil fields The theory has been advanced in the past that the asphalt originated from some section of the bottom of the gulf through an earth disturbance causing emissions of the substance from an underlying deposit

Twentieth Century Manna.—Our Consul in Jerusalem states that manna is found now in the regions of upper Mesopotamia and Kurdistan and along the Persian frontier. It falls, he says, in the form of dew during September, October and November and lodges upon the leaves of oak trees It immediately hardens and assumes the form of a grain. Early in the morning before the heat of the day it is gathered by spreading sheets beneath the trees, which are shaken, and the manna is then collected and stored for winter to be used as a food or shipped to Bagdad for sale in the bazaar The manna falls on other vegetation, including grass, but all of it is lost except that which is gathered from the oak leaves. The manna is sweet and is eaten by the natives as a substitute for sugar or honey

Industrial Efficiency

The Wood Split Pulley continues to hold its own ever since its introduction some forty years ago This type of pulley is claimed to be lighter and more carefully balanced than any metal pulley; the tractive pull of a belt on a wood rim is greater than on an iron or steel rim; and the buyer can generally expect a quicker delivery of both stock and special sizes

Another Victory for Machinery. — From Lyon, France, comes the report that a machine has been developed for making raised embroidery in gold and silver It is stated that the stitch is a copy of an ancient form of embroidery and gives an impression of handwork, and is also the first machine that has been successful in using the metallic thread Various machines have been employed in the making of raised embroidery in other threads It is stated that the machine is the result of seven years of study, and that the results are very satisfactory

Cascara Bark. — A shipment of five tons of cascara bark from the coast valleys of British Columbia has revealed the fact that the only known supply of this valuable medicinal bark, in large quantities, is in British Columbia, the forests in Washington and Oregon having been completely stripped Owing to the depredations of Japanese loggers, who ship to American and British drug firms, this valuable provincial asset is in danger of being exterminated, and steps are being taken to protect this valuable herb in order that it may be properly cultivated and in time become an established industry of British Columbia

France's Hunt for Timber. — Numerous practical experiments have been made by the French Government in order to determine the resistance and durability of the various woods obtainable in French colonies Contrary to the general belief, the timber which abounds in the colonies is not the hardwood employed by cabinet makers but common varieties which are adapted to ordinary construction purposes A uniform commercial name has been given to the many varieties of timber which are closely related from a botanical point of view and suitable for the same purpose The timber has been divided into categories according to its character and the purposes for which it may be utilized.

Firelighters from Clay. — The manufacture of a firelighter from clay deposits found on his land is being undertaken by a farmer in Saskatchewan This deposit is the only known one of its kind on the American continent, although considerable quantities of this clay are also found in Germany The firelighter is in the form of a brick It is soaked in kerosene for a few minutes, and when it has absorbed a quantity a match is applied The brick will burn for a half hour with a steady flame, and when exhausted can be replenished with kerosene and used indefinitely Other uses to which this clay can be put are Kalsomine, filler for paper, cleansing powders, white shoe polish, and brick or tile of the very best quality

By-products from Apples.—What may prove to be a very valuable discovery has been made at Annapolis, Nova Scotia, in a method of extracting valuable by-products from waste and otherwise useless apples It has been found that even the most intensely acid and usually worthless apples may be so treated by a simple process as to yield syrup which has been pronounced eminently desirable as a basis for other concoctions not hitherto so well supplied And not only is this syrup valuable but another by-product has become evident in deposits of calcium malite, the same article as is derived from maple syrup and known as sugar sand Before the war the Germans bought this up extensively in Quebec at $150 or more per pound, as a source of malic acid The process is being treated in two evaporators, and may lead to the development of an entirely new industry in Nova Scotia

Effect of Shorter Hours on British Output.—The annual report of the Chief Inspector of Factories and Workshops for 1919, just issued, disclosed the fact that along with the general adoption, without legislative compulsion, of the reduced 48 hour week, which was accomplished in most British industries during the war period, there has been a coincident decline in the rate of production The experiences of different trades vary quite considerably The average total number of hours of labor per week throughout the industries of the country as a whole amounts now to 47 or 48 In fact, in some factories, it has been reduced to 44 or less This weekly working time is variously distributed according to the local practice, usually determined by a majority of the workers themselves through (1) the five-day week (with no work on Saturday), (2) the single-break day (with only one stop for meals), (3) the double-break day (with two meal times, or, (4) the shift system, with modifications

Germany's Brown Coal

How Teuton Chemists Have Converted the Lowly Swamp Muck Into an Industrial Cinderella

By Robert G. Skerrett

FOR decades brown coal in Germany was generally considered scarcely better than peat for the generation of heat and was used sporadically by people who dug it for their own consumption because black coal was not available or cost too much for their modest purses. Broadly stated, brown coal may be termed bituminous coal in the making—vegetable matter which has not been subjected to the compression and the high temperatures that brought about the formation of the well-known combustible. As brown coal comes from the ground it resembles woody, half-dried peat or muck such as may be found in many swampy forests. Before it is dried the stuff may be cut easily, and when dry the fibrous matter is apparently no more carbonized than the wood so often present in peat beds. The lignite, for such the fuel really is, is certainly unpromising when first dug, for its average moisture content is about 60 per cent, and when most of this water has evaporated the material tends to crumble. This affects both its keeping and its burning qualities more especially if the ordinary grates are used.

Offhand, one might be justified in the assumption that no nation, until hard put to it, would take any serious steps toward exploiting a fuel that seems to have so little to commend it. Yet back in the 'nineties, the Germans saw possibilities in their widespread and well-nigh inexhaustible deposits of brown coal, and with typical Teuton thoroughness evolved, in a comparatively short while, ways and facilities by which the initially indifferent combustible could be transformed into a fuel of undeniable merit. They did this by a briqueting process, and from a friable unstable commodity they made a product that would stand rough handling and endure exposure to the weather for months without disintegrating. Right here let it be emphasized that Germany's brown coal is much inferior in fuel value to most of the lignites that prevail abundantly in certain sections of the United States.

The U. S. Bureau of Mines has kept in touch as far as practicable with what the Germans have been doing in utilizing brown coal, and the data gathered is suggestively of great value. From the facts garnered by our experts it is not hard to realise why the Teutons are undismayed by their enforced separation from the bituminous coal fields which were formerly under their control. The brown coal lies in beds having a vertical thickness ranging from 32 to 328 feet with an average of 72 feet. The deposits are overlaid by relatively thin strata of gravel and clay, and this overburden is removed to facilitate the mining of the coal by open-cut methods. The gravel and clay are cleared away by steam shovels which dump the stuff directly on to cars that carry the spoils to banking grounds. Not infrequently, clay-working plants are operated close by and employ the brown coal for fuel.

When a satisfactory area of the brown coal has been exposed, movable rails are laid and powerful excavating machines of the chain-and-bucket pattern are advanced on them to the desired points of action. There the face of the cut is attacked at an angle of from 45 to 50 degrees, and each machine disposes of a slice of lignite to a depth of 43 to 49 feet. The succession of sharp-edged buckets, trailed by an endless chain, dig into the exposed slopes of the beds as they are dragged from the bottom to the top of the excavation. The buckets empty into hoppers from which the brown coal is loaded into small cars having a capacity of 1.8 cubic yards. One mechanical excavator, calling for the attendance of only three men, can cut about 1,650 tons in the course of 24 hours. The filled cars are drawn by locomotives to a station where they are attached to a chain belt which pulls them up an incline to the upper floor of the briquet factory. When the excavations reach still deeper, the chain-tractor system is extended to the terraces adjacent to the steam diggers, and the laden trams are then hauled right from the pits without the aid of locomotives.

One of the best examples of a brown-coal briqueting plant is that at Zisselsmarr, in the neighborhood of Cologne. It is a substantial brick structure placed close to the pit, and is typical of kindred factories reared at numerous points throughout the lignite fields of Germany. The establishment is supplied daily with 800 carloads of the raw material, each load weighing 1,820 pounds.

The lignite is passed through one or two pairs of crushing rolls and is screened by inclined vibrating sieves, and such of the stuff as still remains coarse is carried through a third crusher. The woody parts and hard lumps which will not drop through any of the sieves are taken by a belt conveyor to the boiler furnaces and there burned. In the course of ten or twelve hours enough brown coal is crushed and screened to supply the briqueting machines for a period of twenty-four hours. One man can look after the functioning of two sets of sieves.

The duly crushed, fine, moist lignite is distributed by belt conveyors to bins near the driers. The driers are sheet-iron cylinders 28 feet long and 10 feet in diameter, supported on trunnions and mounted longitudinally at an angle of 7 degrees from the horizontal. Each drier contains an inner cylinder carrying more than 860 four-inch tubes set parallel with the axis of that drum. Exhaust steam from the plant engines circulates around the tubes through which the damp coal is moved continually under the impulse of spiral feeders. The speed at which the ground material travels through the drier depends upon its moisture content. When this is 60 per cent the passage takes about 45 minutes; and during that time the moisture is reduced to 15 per cent. There are several driers, and each has a capacity of 77 short tons of dry lignite every twenty-four hours. It is said that the air in all parts of the establishment is substantially free from floating dust by reason of certain precautionary features, and this effectually obviates any risk of dust explosion—a danger that was not absent from some of the earlier briqueting factories. Before the war the drying cost was 17½ cents per ton of product.

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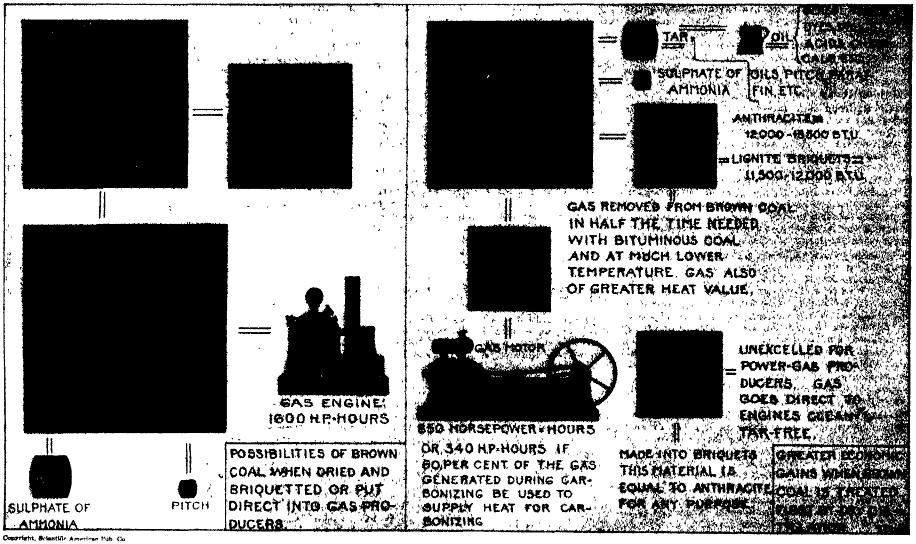
SULPHATE OF AMMONIA
PITCH
GAS ENGINE: 1600 H.P.-HOURS
POSSIBILITIES OF BROWN COAL WHEN DRIED AND BRIQUETTED OR PUT DIRECT INTO GAS PRODUCERS
TAR
OIL
SULPHATE OF AMMONIA
OILS, PITCH, PARAFFIN, ETC.
ANTHRACITE = 12,000-13,500 B.T.U.
= LIGNITE BRIQUETS = 11,500-12,000 B.T.U.
GAS REMOVED FROM BROWN COAL IN HALF THE TIME NEEDED WITH BITUMINOUS COAL AND AT MUCH LOWER TEMPERATURE. GAS ALSO OF GREATER HEAT VALUE.
GAS MOTOR
850 HORSEPOWER-HOURS OR 340 H.P.-HOURS IF 60 PER CENT. OF THE GAS GENERATED DURING CARBONIZING BE USED TO SUPPLY HEAT FOR CARBONIZING
= UNEXCELLED FOR POWER-GAS PRODUCERS. GAS GOES DIRECT TO ENGINES CLEAN & TAR-FREE.
MADE INTO BRIQUETS THIS MATERIAL IS EQUAL TO ANTHRACITE FOR ANY PURPOSE
GREATER ECONOMIC GAINS WHEN BROWN COAL IS TREATED

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Diagrammatic showing of the benefits that Germany can reap by the skillful use of her inexhaustible beds of brown coal

From Brewing Beer to Raising Mushrooms

By M. A. Henry

OF all the myriad problems growing from prohibition there is none more baffling than what to do with the breweries. Aside from the making of "soft" drinks, for which there is but a limited demand, there seems to be no good use to which the plant and equipment of a brewery are fitted. Worse, the expert training of the personnel is equally useless. But the owner of a famous old brewery in New York City believes he has found an answer; and the answer is mushrooms!

It may seem, at first thought, to be a far cry from beer to mushrooms But a closer examination of the facts reveals a rather intimate connection The process of making beer is largely one of growing a species of yeast cells in a liquor obtained from malt and hops Yeast is a first cousin to the mushroom; each is a colony of cell growths from the same family tree, and the cell growths are propagated best under similar conditions. Thus the brewing plant, with its refrigerating machinery and dimly lighted interior is admirably suited for the growing of mushrooms when growing frames have been substituted for the beer vats. Furthermore, the expert knowledge of the master brewer is entirely useful in preparing the mushroom spawn for the beds and in controlling the growing conditions

This does not mean that brewers are assured of success as mushroom growers without studying the new subject, or without experiment, but if proper precautions are taken there is every prospect of success In the one brewery where the plan has been given a thorough test, although in the heart of New York City, the "mushroom plantation" bids fair to surpass in fame and profits the plant's record as a brewery

Being fond of mushrooms as a table delicacy and having experimented in their culture, A. G Hupfel, Jr., decided not to let his big plant be submerged in the tidal wave of prohibition, but, instead, to turn it to account in this unique undertaking He called to his assistance a man who has had thirty years' experience in developing the mushroom industry in France After a thorough survey, he put in about 100,000 square feet of beds after the French practice These are narrow, rounded beds of rich loam in pairs and were placed in the cellar of the plant which is carved from solid rock. Thus were approximated the conditions under which mushrooms are grown commercially in the many caves in solid rock near Paris, which became famous during the war as places of refuge during bombardments.

Later a system of flat beds built in tiers was adopted as this allowed a great increase in bed area for the same floor space. Then began a series of remarkable experiments to determine the best production methods

The first mushrooms were grown from spawn secured through the regular commercial channels, but this was found not to be of uniform quality Of two beds planted side by side with the same spawn and treated in identical manner, one would often bear prolifically while the other would be almost barren

The production of spawn was then undertaken In the growing of brewing yeast, a single cell is isolated under the microscope and this is "planted" in a bottle of gelatin. In a few days the cell has multiplied until it appears as a spot of white mold on the gelatin Then it is transferred to a jar of specially prepared liquor and the mold increases in size until it fills the jar These "roots" are separated again and again and placed in other jars until, from a single cell invisible to the eye, sufficient yeast has been produced to make a brewing of many thousands of gallons An exactly parallel process is used in making mushroom spawn The single "mother" cell is taken from the underneath side of a good specimen of mushroom, chosen from a spot in the beds which bore prolifically Care is taken to secure a cell which is not contaminated A number of cells are planted simultaneously and the best of the growths from these are transplanted to the "root" jars From this small beginning enough spawn is secured to plant all of the beds of the plantation The great delicacy of this operation may be judged from the fact that there are in this country only two concerns, aside from this brewery, which have succeeded in producing spawn on a commercial scale

Noting the rapid growth of mushrooms in the natural state immediately after a thunder storm, experiments were begun to determine the response of culti

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Testing the resistance between rails in order to determine the condition of ties and roadbed and the leakage

Testing Roadbed Conditions by the Resistance Method

By S. R. Winters

THOUSANDS of people who annually frequent railway trains can easily distinguish between a roadbed that unduly jars the speeding train and one that lends itself to the ease and comfort of swift travel Other citizens, possibly, are not alive to the varying elements which enter into roadbed construction until defective ties are responsible for a train derailment of serious consequences. Not content with casual observations, however, the National Bureau of Standards and the Forest Products Laboratory jointly conducted a series of investigations revealing the conditions of a roadbed which inure to durability of construction of the equipment and safety of speeding trains

For example oil is more efficient than straight creosote as an insulator in barring moisture from ties Likewise, oil has possibilities of minimizing leakage currents and as a preservative of the wood against decay Ties treated with zinc chloride offered a lower resistance than test specimens bathed in oil and creosote The test section in which scrubbed ties were used evidenced a slightly higher resistance than the section not thus treated The resistance of sections in which new and old untreated ties were employed, respectively, were twice that revealed by roadbeds with chemically treated ties and one half that found for tracks with oil-treated ties

The resistance measurements of steam railway roadbeds were determined by a series of observations between various test sections from which the resistance to earth of each section was calculated The isolation method as applicable to street railway tracks proved impractical No water piping system was accessible for an earth connection and the track network, not being bonded, could not easily be employed in this rôle A battery of four dry cells was connected between two remote sections of the test tracks and the current flow and voltage noted The observation was repeated for various pairs of sections From the results of a series of measurements it was possible to establish a number of equations, the simultaneous solution of which gave the resistance of each section to earth

Transplant the base of operations from Madison, Wis., to Washington, D C and the conclusions of similar investigations with street railway roadbeds are available The Bureau of Standards even built sections of experimental roadbeds in order to variegate the facilities offered by local electric railway companies for conducting the tests The investigations, it would seem were among the first to emphasize the possibilities of insulating roadbeds or constructing them in such a fashion as to curtail the leakage of electricity from street railway tracks A portable storage battery connected between four rails of a track and a water hydrant on a large main was included in the measuring equipment An ammeter and a regulating resistance were included in the circuit, as well as nine Edison storage cells providing a constant

(Continued on page 318)

Left: Original method employed in brewery for raising mushrooms, using narrow, rounded beds of rich loam in pairs *Right:* Later method of raising mushrooms, using tiers of flat beds and increasing the bed area manifold for the same floor space. *Above:* Harvesting the mushrooms for the day's supply to the New York hotels

How mushrooms are raised in a New York brewery where formerly yeast was grown for beer

Solving the Labor Problem—V

Educating and Training the Man to Fit Him to His Job

By Charles Frederick Carter

HENRY, an office boy, was discharged by the New York Edison Company for using bad language in the presence of women workers Although only fifteen years old, Henry had already developed symptoms of common sense which he manifested by seeking the office manager a few hours later, expressing contrition for his conduct and asking for reinstatement He said his father was dead that his mother took in washing to support the family, which included a little sister, that he had had to leave school because his meager earnings were needed to piece out the family's scanty income, and that he wanted a day job so he could go to night school to fit himself to earn enough to relieve his mother of drudgery Then he went home and told his mother all that had happened Next morning she appeared at the office to support Henry's plea She said if he was given another chance she felt sure he would appreciate it Henry was taken back

This incident was the first in a sequence that led to the organization of the National Association of Corporation Training, which, ten years after Henry was discharged, includes in its membership 154 corporations having an aggregate capitalization of six billion dollars and two million employees, and this association is but a single manifestation of a great National movement for training employees—for fitting the man to the job—which Theodore Roosevelt, a short time before his death, pronounced the greatest development of the age It may not be amiss to add that Governor Miller, of New York, and President Harding have expressed a keen interest in this movement and a determination to do all they can to further it

NO matter what may be the nature of the work, the employee with a certain amount of education and training is preferable to one without such education and training. Education and training may mean better work, a spirit of cooperation with other workers brought about by a better understanding of the production processes, and certainly a fairer insight as to the relationship between employee, foreman, superintendent, and officials of the organization. With these facts in mind, there was formed some years ago a country-wide organization known as the National Association of Corporation Training, for the purpose of coordinating the educational work of all corporations. Guided by eight years of constructive development the members of this association are making substantial progress toward minimizing waste through lack of proper training, labor turnover and avoidable sickness and accident, and that is precisely the story we have asked Mr. Carter to write for us as another instalment of our Solving the Labor Problem series.—THE EDITOR.

To set down events in order, this affair of Henry's brought home to the New York Edison Company for the first time the importance of having in the commercial department where they came in contact with the public only employees who understood and observed at least the ordinary courtesies of life and had at least the equivalent of a grammar school education The management reasoned that Henry's delinquency was not due to innate depravity but to ignorance, that if experience had demonstrated anything it had shown that Henry was typical of most of the raw material from which junior office help might be recruited, that instead of incurring the inconvenience annoyance and loss inevitably associated with a perpetual round of hiring and firing it would be much wiser to give the force already in hand such training as might be required to fit it, not merely to hold present jobs, but to qualify it for advancement Experience with a technical course for employees in mechanical and electrical departments instituted some five years before confirmed this conclusion

Twenty-eight boys and girls in the commercial department were found to be so poorly educated they could not pass the simplest examination So in 1911 the company announced that a class for junior employees to be conducted by F C Henderschott would be organized to take a course corresponding to that of a grammar school with certain special subjects pertaining to the business Henry and thirteen others welcomed this opportunity to fit themselves for their life work, the other fourteen resigned rather than have their personal liberty to continue an incompetent, poverty stricken existence curtailed

Just to show the sort of material from which the company had to mold its office and selling staff, an examination early in this first course elicited the information that the principal three cities in New York were Buffalo, Philadelphia and Massachusetts that the principal mountains in the state were the Rockies and the principal valley the Yosemite, and that the Erie Canal was dug to afford more direct route to the East Indies

At first glance this may seem humorous, but when it is realized that the boys and girls 15 to 18 years old who gave these answers were launched on the world to make their way so fearfully handicapped, and further, that they were fairly representative of the material from which corporations which serve the public must recruit their employees, the matter ceases to be a subject for laughter and becomes tragic.

Under the energetic tutelage of Mr Henderschott the class made rapid progress All are now filling responsible positions Henry is now a general representative of the company at a good salary His mother is released from the tub and his sister is in high school.

The company was encouraged to make a rule that all employees, in the Commercial Department, regardless of length of service, should take instruction Six gray haired men past fifty felt they could not aspire to higher positions and so asked to be excused But after two or three meetings of the class had been held two of the six, both grandfathers, asked to be enrolled One was a solicitor for signs at $18 a week, now he is in charge of all exhibits of electrical appliances at a much larger salary, the other who was agent in a district office became assistant general manager at headquarters The four who declined instruction have not advanced

Mr Henderschott, the instructor, was making as rapid progress as his pupils He learned that other corporations were feeling the need for more competent help as keenly as his own, yet, despite this great need only thirteen other corporations were making any attempt to train office help While a few far seeing corporations had been making rather desultory experiments in apprenticeship courses to maintain their mechanical departments, and while vocational training was beginning to arouse a good deal of interest, it was making little progress because it was in the hands of academic teachers Mr Henderschott took the initiative in forming an association that would coordinate the educational work of all corporations which had undertaken anything of the kind, and that would induce others to take it up Through bulletins, reports, annual conventions and more frequent meetings of local "chapters" members could have the benefit of each other's experience and thus reduce to a minimum the inevitable mistakes of pioneer work.

Beginning in 1913 with a membership of 48 corporations the National Association of Corporation Schools rendered such valuable services that it won the interest and support of many of the largest employers in the country, including such representative concerns as the Westinghouse Electric and Manufacturing Company, the General Electric Company Carnegie Steel Company, American Bridge Company, Illinois Steel Company, Solvay Process Company, Standard Oil Company, of California, National Cash Register Company, H J. Heinz, W R Grace & Co, Yale & Towne, Pennsylvania Railroad Company, Federal Reserve Bank of Chicago and New York, Montgomery, Ward & Co, Metropolitan Life Insurance Company, Travelers' Insurance Company Pressed Steel Car Company, International Harvester Company, Armour & Co, and others of that type, to the total of 154, as already stated, L L Park, Vice-President of the American Locomotive Company, is President and Mr Henderschott is Treasurer and Managing Director of the organization under its present title of the National Association of Corporation Training

While other agencies have contributed to the result it is chiefly due to the activities of this association and its individual members that personnel problems are now receiving at the hands of practically all progressive employers in America the same degree of attention as those relating to production, marketing, traffic, accounting and finance Guided by eight years of constructive development the members of this association are making substantial progress toward minimizing waste through lack of proper training, labor turnover and avoidable sickness and accidents.

Perhaps the key to the activities of the association and their scope may be found in the list of subjects assigned to seventeen subcommittees to study and report upon at the ninth annual convention next June The list is as follows: Application of psychological tests and rating scales in industry; employment; executive training, foreman training; health education; job analysis, labor turnover, marketing; office work training; profit sharing and allied thrift plans; public education; skilled and semi-skilled labor; technical training, trade apprenticeship; training for foreign commerce, unskilled labor and Americanization; visualized training (*i e*, the use of motion pictures for training purposes).

Possibly a still better idea of what the more progressive employers are doing to contribute to the mutual benefit of all concerned in industrial and commercial enterprises, develop the efficiency of the individual employee and coordinate his best interests with those of his employer, may be found in a résumé of the educational activities conducted by the Westinghouse Electric and Manufacturing Company for the benefit of the twenty thousand employees at its East Pittsburgh plant

First is a trade apprentice course of four years in the more important trades, such as draftsmen, pattern making, foundrymen, machine tool making for mechanical and electrical departments. The apprentices work mostly in material and machine shops There is a special department for preliminary training The minimum of class-room training is four hours a week throughout the course. Graduate apprentices and those still serving may enroll in the Casino night technology school under separate management but largely supported by the corporation where they can receive instruction in physics, chemistry, metallurgy, theoretical electricity, applied electricity, power and mechanics, mathematics, engineering and shop problems and applied design If needed, pupils must take a course in English

There is also the Westinghouse Club which provides lectures on subjects of general interest and on theory and design For college graduates who may wish to specialize in works management, sales, or engineering and design, there are special one-year courses For those who have put in two years at college there is a special two-year apprenticeship. Another special course is for those who plan to go to foreign countries as operatives or salesmen Finally, there are special daily lectures for executives and members of the clerical staff on the design and use of the products of the company, the technical principles underlying shop practice and the work of the associated plants

From this schedule, which may be taken as fairly representative of the most advanced practice, it will be seen that no one from the newest office boy to the veteran executive is considered by up-to-date employers to be beyond the need of training. Indeed, it is dawning upon the managements of great enterprises that foremen and higher executives are quite as much in need of training to fit them for their jobs as the workmen. Developments in applied science are swift and continuous; but still more important is the knowledge of the art of handling human beings, in which foremen and other executives are, or should be, versed.

There is a growing recognition of the fact that the good will of employees is as valuable as that of customers, to secure which so much energy, thought and money are devoted No concern which advertises as its motto that "the customer is always right" has had the temerity to extend that attitude to the adjustment of complaints of workmen; but an increasing number is manifesting a lively solicitude regarding the treatment of employees. When one has invested anywhere from

(*Continued on page 319*)

The New Commissioner of Patents

MR THOMAS E. ROBERTSON, who has been appointed by President Harding to be Commissioner of Patents, was born in Washington in 1871, where he has been for many years active in the work of the American Patent Law Association, of which he is a former president. The Commissioner, who has been a life-long resident of Washington and Chevy Chase, Maryland, is a man of high personal character, who is held in great regard in the Washington fraternity of patent attorneys.

The appointment of a new Commissioner of Patents is a matter of vital concern in a country which is so prolific in invention as the United States; and the fact that Mr Robertson not only comes of a family of inventors and lawyers but is himself a well-known patent attorney of long standing will give widespread satisfaction.

The new Commissioner is a graduate of the National University Law School, and he also took a course at Columbian, now George Washington University In addition to having filled the position of president of the American Patent Law Association, he is a member of the bar of the United States Supreme Court the District Court of Appeals and the Court of Appeals of Maryland Mr. Robertson is a member of the University Club and the Washington Board of Trade

Mr Robertson's father, Mr. T J W. Robertson, who is still living, was interested, prior to 1867, in the production of inventions, having invented many improvements in sewing machines and in engraving machines for cut glass, and a postal canceling stamp In connection with these inventions he was associated with Mr. Alfred E Beach, one of the founders of the Scientific American, and from 1867 to 1876 he was an employee of the Washington office of the firm of Munn & Company, finally leaving the firm to go into business for himself For some time Mr Robertson, Sr., was Washington correspondent of the Scientific American, and throughout his long life has maintained his interest in inventions and patents.

Mr. T J W. Robertson's oldest son, Alfred Beach Robertson, who was named after Alfred Ely Beach, and was also a patent attorney, was employed with his father in our Washington office

Identification of Oak Woods

OVER fifty species of native oaks assume the proportions of trees, and about twenty-five are used for lumber After the oaks are cut into lumber, there is no means known to the United States Forest Products Laboratory by which they can be identified as to exact species By examination of the wood alone, however, it is easy to separate the oaks into two groups—the white oaks and the red oaks, and for most purposes, fortunately, it is not necessary to classify them any further The oaks all average about the same in strength, but those in the white oak group are much more durable under conditions favorable to decay than those in the red oak group

The white oak group includes true white oak, swamp oak, bur oak, cow oak, post oak overcup oak, and chestnut oak The red oak group includes true red oak, yellow or black oak, scarlet oak, Spanish oak, Texas oak, black jack, water oak, willow oak, and laurel oak

The color of the wood is a ready but not absolutely reliable means of distinguishing the white oaks from the red oaks. Red oaks usually have a distinctly reddish tinge, especially near the knots. The wood of the white oaks is generally a grayish brown; but occasionally a reddish tinge is found in white oak lumber

For more accurate identification it is necessary to examine the pores of the wood. These will be found as tiny holes on a smoothly cut end surface, the largest being visible to the unaided eye. They are not of uniform size throughout each growth ring, but are considerably larger in the wood formed in the spring, decreasing in size rather abruptly toward the summerwood The large pores in the springwood of the heartwood and inner sapwood of the white oaks are usually plugged up with a froth-like growth called tyloses, and those of the red oaks are open This feature, however, is not so reliable for classification as the character of the much smaller pores in the summerwood

To tell for a certainty whether a piece of oak belongs to the white or red oak group, cut the end grain smoothly with a sharp knife across several growth rings of average width. With the aid of a hand lens examine the small pores in the dense summerwood. If the pores in this part of the growth ring are plainly visible as minute rounded openings, and are not so crowded but that they can readily be counted, the wood belongs to the red oak group If the pores in the summerwood are very small, somewhat angular, and so numerous that it would be exceedingly difficult to count them, the wood belongs to the white oak group.

Heat-Proof Rust-Proofing

EVERYONE who has ever compared the upper and under surfaces of a steel rail will realize that metal surfaces which are not properly protected from the atmosphere, either by operating contact with other surfaces or by a definite protective coating of some foreign substance, deteriorate rapidly under the rusting influence of the air A plow on the farm that should last twelve years ordinarily lands in the scrap heap during its third year through this destructive agent, and this is but one example that might be given out of many

An especially troublesome phase of this problem is met with in warehouses and stock rooms, where the storage, for considerable periods, of finished metal parts is absolutely necessary It is customary to coat such parts with a grease of some sort as a protection against the ravages of the atmosphere, but the temperature in storage places of the character mentioned often attains a surprising degree of super-heat as compared with the surrounding free spaces, causing the grease to run and leave the metal exposed

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Thomas E. Robertson, the newly appointed Commissioner of Patents

There was recently demonstrated in New York a new protective coating which is less open to this objection than any we have previously seen In a very severe test the new substance, placed on a metal block in a rather large daub, not only refused to run at temperatures which reduced all its competitors to the consistency of water, but actually retained its shape at these temperatures, and did not begin to slide until the heat went close to 200 degrees Yet in spite of this resistance to melting, the product in question was easy to apply in a properly thin coating The manufacturers of the new protective material are highly confident that it furnishes an absolute insulation against rust, and that it will stay on at any temperature which can be reached outside of an actual conflagration.

John Burroughs

THAT brave and genial naturalist, one of America's greatest old men, has passed away John Burroughs had spent the winter in California in the hope of regaining his lost health, but the trip was too much for the octogenarian and he died on a train in Ohio while on the way to his home "Riverby," near Poughkeepsie At the time of his death his mind was so alert that few could believe that he was to have an eighty fourth birthday, yet on this birthday he was buried on the mountainside at Roxbury where he was born From all over the peaks and valleys of the Catskills old neighbors came to pay him final honors, while his chums of later life, Thomas Edison, Henry Ford and Harvey S Firestone, stood beside the open grave The simple rites were soon over and the purple haze of dusk descended on the village as the mourners wended their way down the mountain and John Burroughs was alone with the nature he loved so well

Perhaps the appreciation of Burroughs as a power in the realm of nature can best be summed up in the words of another naturalist of great note, Prof Henry Fairfield Osborn, who said

"In the passing of John Burroughs, all who love nature and feel kinship with other nature lovers, have suffered a great loss An earnest student of natural history he never lost the realization that 'Nature is a volume of which God is the author' His appeal and his value as a teacher of young and old alike make his death an irreparable loss"

John Burroughs, "student of mice and men," began his study as a naturalist in the days when the Western plains were still overrun with buffalo and when species of animals and birds now approaching extinction, were so numerous that they excited no curiosity except among born naturalists

As the years rolled on Burroughs became famous as a naturalist and writer on nature topics and the paths of persons interested in the study of wild life led to his home, Riverby, overlooking the Hudson, and to his summer study, "Slabsides,' a house built by himself out of bark-covered boards, the first cuttings off the log He became known as a patriarch, and interest increased in his work as he and the late John Muir naturalist of the Sierras, and Theodore Roosevelt, "naturalist of the White House," made their joint trips in the study of wild life and natural phenomena in various parts of the country

When Roosevelt was in his controversy with the 'nature fakers Burroughs rushed to his assistance with the assertion that the 'White House naturalist" was a real naturalist and was correct in his assertions about animals and birds He and Roosevelt were mutual admirers, and frequently expressed their appreciation of each other's work as naturalists

Hearing a Shadow

WE have all heard of the proverbial pin to be heard dropping and the silence which could be felt, but Mr Graham Bell made a statement on May 17, 1878, that he could 'hear a shadow' (by interrupting the action of light upon selenium)

Professor Willoughby Smith carried out this idea and soon after heard the sound produced by the action of a ray of light upon a bar of selenium in connection with a telephone

The experiment excited great interest at the time because the telephone and photophone were in their infancy How was it done? A series of flashes of light were let fall on selenium, causing intervals of light and darkness The strength of the current continually varied, and, if the flashes succeeded each other quickly enough, and with sufficient regularity, a musical note was heard by a person listening at the telephone Moreover, by placing a small mirror whereby light may be reflected upon a distant selenium cell, aided by lenses suitably arranged, Professor Graham Bell was able to obtain articulate sounds at about 700 feet

Selenium was not much known in 1878 when it was discussed at the Royal Society, London It is a rare element, somewhat resembling sulfur In its vitrous state it is a bad conductor of electricity, but in its crystalline state it is a very good one and when exposed to light the electric resistance is a great deal diminished

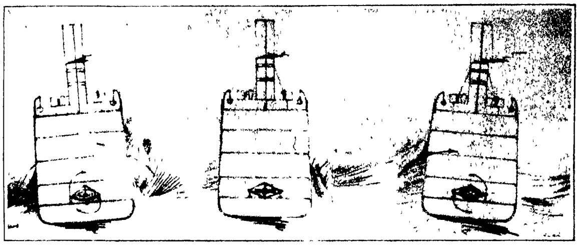
Preventing the Roll of Ships

Past and Present Schemes for Stabilizing Ships and Why the Gyroscopic Stabilizer Is Practical

By J. F. Springer

For many years there have been serious attempts to develop some reliable method of preventing the roll of ships at sea. Naval people especially have been interested, as the roll disturbs the effectiveness of gun fire. As far back as a couple of score years ago, the British and also the Germans sought to utilize great tanks of sea water in an effort to control rolling. In fact, as E. A. Sperry tells us, such tanks were actually installed on two war vessels. Later on the Americans tried out the action of tanks, one ship having had installed upon her no less than three such devices.

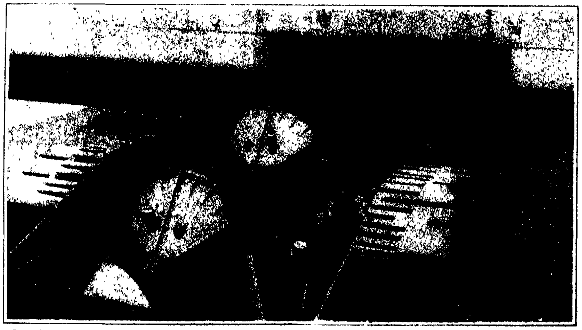
The difficulty encountered by the foregoing-mentioned method of controlling the roll seems to center on the fact that there are three periodic movements of heavy bodies. The ship rolls in a period natural to herself, the waves have a periodic motion, and the water in the tank has a period of its own. To bring unison out of the three seems to have proved practically impossible. Besides, the size and weight of a loaded tank makes a considerable reduction in the net carrying power of the vessel.



The action of the modern ship stabilizer, showing how the gyroscope neutralizes the effect of each wave

The British made another important attempt to control the roll. This was in the time of Sir John Thornycroft. He made use of a big horizontal pendulum. It was located down in the hold and was operated by hydraulic means. It seems that development was halted by the realization that the relative weight necessary for the pendulum was really prohibitive. The Germans tried the tank method and also one dependent upon what may be called the passive gyrostat. Without going into details, suffice it to say that all these efforts to produce a stabilizer of reasonable weight and capable of satisfactorily controlling the ship have failed of general adoption either in the Navy or the Merchant Marine.

It has remained for America to grasp the essential idea. A weight having a slow motion—such as the water in a tank or the heavy pendulum—could not develop an adequate moment because of the limitations on the weights it was permissible to allow. By giving swift motion to a weight, however, the power of control is greatly increased. This is what is done in the active gyro stabilizer which has already been tried out. A notable installation is the one on the U. S. S. "Henderson," an army transport ship built at the Philadelphia Navy Yard. This vessel has been in operation with a displacement as large as 11,500 tons. We are assured that the guaranteed stabilizing moments have been easily developed.



Installing the gyroscopic stabilizer on the U. S. S. "Henderson", an Army transport ship of 11,500 tons

The present device seeks not so much the reduction in the roll of the ship as the prevention of all roll. The results are secured by applying artificial precession. The rotating mass of the rotor represents great latent energy and derives its importance largely from the enormous velocities with which moderate weights may be moved. As the inventor says: "A comparatively few pounds are actually capable of doing the work of tons. With the active gyro, this is all held in phase, and is available for the important purpose of holding the ship free from even the beginning of roll."

An important matter relates to the increases in size and cost as larger and larger ships are equipped with the proper plant. The stabilizing power varies as the 5th power of the linear dimensions. This means that a gyroscope, capable of 32 times the power of a given one, would nevertheless have to have linear dimensions only twice those of the less powerful machine. The reason for this is that 32 is the 5th power of 2. However, the weight and cost go up at a good rate but at one much less than the 5th power of the linear dimensions. Naturally the weight increases as the cube, so that for the gyroscope of double dimensions the weight would be multiplied by the cube of 2—that is by 8. The cost goes along with the weight. We have then the result that a gyroscope having 32 times the stabilizing power of another will weigh only 8 times as much and cost only 8 times as much. The big ship thus has a great relative advantage over the smaller one, as its gyroscope equipment will not weigh anything like what the size of the ship would indicate, nor will it cost anything like the relative amount. The problem and the cost reduce, relatively, as the size of the ship increases.

The manner of stabilizing is a matter of interest. The ship is not held as in a great vise, with the waves free to beat against it. The ship goes with the waves much as a western America rider goes with his horse. There is, practically, no contest between wave and ship. The result of an experience based on a large number of installations in actual service is said to be to the effect that a ship freely riding the waves with its mast held vertical by the relatively small gyroscope installation, has to undergo less than 1/6 to ¼ of the strains imposed when put under precisely the same conditions apart from the gyroscope. So, then, instead of the gyroscope adding to the stress and strain, it minimizes them. The slow precessional movements of the rapidly rotating gyroscope may be instantly started up or stopped, at the will of the operator. This gives opportunity to note the behavior of the ship with and without gyroscopic stabilizing, but with all other conditions the same. Among the changes produced is the cessation of creaks and groans of the ship working along in bad weather. These may be very noticeable with the ship under ordinary control. When the stabilizer is put into action, it is understood that these instantly cease. This means, no doubt, that the racking of the vessel has also come to an end. It appears that the eminent British naval architect, Sir William White, has indorsed this view. He stated that, from the point of view of the naval architect, the strains introduced by the use of the gyroscopic stabilizer for the purpose of holding the ship in a free riding position were negligible. He thought that the strains and stresses were only a small fraction of those otherwise set up by a ship actually rolling in a storm.

In fact, Sir William gave it as his opinion, at a time when apparently there had as yet been no actual test in a rough sea, that the vessel stabilized by the gyroscope would not ship seas but would upon stabilization commence to be dry and would subsequently stay dry. This in itself is a very large matter, quite apart from the remaining advantages of the prevention of rolling. What Sir William then thought has since been found to be true. It will perhaps be gathered from the foregoing that the use of the gyroscope prolongs the life of the ship and eliminates the hazards incident to seas washing over the decks. The advantage to a passenger ship in respect to the comfort and safety of the passenger is rather obvious. But there are still other advantages, not so obvious. When a ship rolls, there is a displacement of water in the direction perpendicular to her length. This arises from the fact that the wetted surface is not molded to the form of a cylinder. These displacements of water involve the expenditure of power for the reason that the vessel is continually being shoved ahead by her propellers. In short, because of the non-circular outline of a cross-section of the wetted portion, the ship's power plant expends a part of its energy in overcoming the extra resistance. What really happens is, naturally, a reduction in forward speed. This means a money loss. It has been estimated that the power loss to a ship of 37,000 tons running at 22 knots might very well amount to 8,100 horsepower.

There is another economic advantage that affects the cost of operation. When a ship is permitted to roll, the course cannot be rigidly held. The ship requires "helm", and this requirement, even when slight, necessarily involves a slowing down of the vessel. Further, as the rolling ship does not maintain a straight course but pursues a sinuous one, the effect is to reduce the actual speed on the desired course. Not only is there a lengthening of the path, but there results a "bad angle of attack." This means further loss of speed, an extra consumption of power—that is, a money expense.

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Left: Crucible in position, ready to pour thermit steel into the mold. *Center:* Acute angle thermit-welded crossing for double-track street railway and single-track steam railroad intersection
Right: Yellow pattern wax applied to the frog and molded to the desired weld A mold is then constructed around the wax model which is then burned out to form a mold for the metal

Two steps in the welding of steam railroad track crossings and an example of the intricate trackwork made by this method

Constructing Steam Railroad Track Crossings by Means of Welding

THE first steam railroad track crossings ever constructed by welding rail arms into frogs have recently been placed in service in St Joseph, Mo, at certain intersections of the street railway track with the steam railroad lines. As this special work is the first of its kind to be installed in steam railroad track, it will be interesting to observe how this form which has proved so successful for street railway track will stand the exceedingly heavy traffic of steam roads

The frog was made from street railway girder rails, but the general method of welding the steam railroad tee rail frogs is the same The ends of the rail pieces which form the frog are cut to the desired shape with an oxy-acetylene torch They are then lined up together and clamped on a layout bed, leaving a slight opening at the frog for the insertion of yellow pattern wax which is molded to the shape of the desired weld The mold is then constructed around the wax pattern and wooden riser and pouring gate patterns inserted to allow space for the pouring of the weld These wooden patterns are later removed and the wax burned out of the mold by means of a preheating torch, which also serves to heat the rail ends forming the frog to a good red heat, suitable for welding.

A charge of thermit, which is a mixture of iron oxide and aluminum, deposited in a crucible suspended over the mold, is then ignited A chemical reaction takes place, during which the aluminum combines with the oxygen of the iron oxide to form aluminum-oxide (or slag) in a highly super-heated molten state, while the iron is set free and is produced as liquid steel at approximately 5,000 degrees Fahrenheit This liquid steel is then tapped through the bottom of the crucible into the mold and amalgamates with the rail sections to be welded, so that finally the entire mass will cool down to form a single homogeneous section

Track welded special work can be made at the nearest place where a supply of compressed air is available and the completed layout then transported to the crossing and quickly set into position with a minimum delay to traffic In the case of double track crossings, two halves of the crossing can be constructed in the shops and the projecting arms of each half later welded together at the crossing. The advantage of the welded crossing, with no tie plates, bolts or other accessories, are obvious. In fact, it combines the numerous elements into a single strong, uniform, jointless track work

Looking down a street in Scranton, showing a row of collapsed houses due to undermining

The Undermined City of Scranton and Its Underground Fires

FOR years the residents of Scranton in the heart of the Pennsylvania coal fields, have had the rather unpleasant sensation of momentarily expecting their houses to fall from under them Likewise with their land and their streets and their places of business, for a good part of the city of Scranton covers former and present mine galleries which cave in at times, and thus take away the support of whatever happens to be but a short distance overhead

The accompanying views tell better than words what a menace certain residents of Scranton have been facing of late Here we have residences and business buildings toppled over and collapsed by the settling of the ground on which they have been built Fortunately, this has occurred in but one section of the city but nevertheless the damages and losses have been severe

Quite recently the residents of lower West Scranton have been living over a raging furnace while mine officials and city authorities have been exerting every effort to determine the exact location of the subterranean fire It appears that a fire has been raging for years in what is known as the Continental mine But the recent fire is apparently another fire and it is now believed that there have been two mammoth mine fires instead of one and that the flames have been spreading over an underground area of approximately 50 acres While there has been no immediate danger to the thousands residing over this particular area officials feared that if any surface settlings should occur while the blaze was raging the fumes of gas sulfur and black damp would seep through the crevices and possibly enter the homes of the residents, proving fatal in such cases

At any rate, it is not the most pleasant sensation in the world to be living or doing business right over a coal mine

Realizing all this the municipality of Scranton has appropriated a large sum of money and taken steps to put an end to the menace of such long standing

Copyright, Keystone View Co.

What the settling of the ground due to the undermining of a section of Scranton has meant to property owners, and a collapse of a street and the bursting of a water main due to mining operations

Finding Jobs for Radium

Facts and Figures Regarding the Many Uses to Which This Most Precious of Metals Is Put

By Harry A. Mount

THE visit to this country of Mme Curie, the French scientist who first isolated and named radium, and the presentation to her of a gram of the precious element, *directs attention to the fact that the United* States has become within the brief space of a few years the world's producer of radium. Indeed, of an anticipated world production of 25 grams of radium in 1921, practically all will come from this country.

Twenty five grams of radium sounds quite little when compared with the world production of any other precious metal. But when it is reflected that there exists in the whole world only about five ounces of extracted radium, the production of nearly an ounce a year is large. But what will become of this ounce of radium?

This is a pertinent question, for recently it has been proposed that the use of radium be restricted by legislative action to medicinal uses. The action is inspired, no doubt, by the fear that so much radium will be used in the production of luminous material for the faces of watches and clocks and similar uses that humanity will be deprived of the medicinal benefits that would otherwise come from this radium. Another fear is that the visible supply of the ores which now furnish the radium of commerce will be exhausted and that the annual production will be greatly curtailed.

The second objection is most easily disposed of. When at the outbreak of the World War the importation of radium from Europe was cut off and mines were opened in Colorado and Utah, it was seriously proposed to limit the use of radium to medicine when experts predicted that not more than 100 grams of radium could be taken from the carnotite deposits there. But more than that amount has already been taken out and the visible supply is greater than ever before. New deposits are being constantly discovered and within the past month prospectors have announced additional deposits estimated to contain 90 grams of radium.

There has been a great deal of speculation among mining engineers, commercial users of radium, Government authorities and others as to whether the supply of radium would be continuous. The present fields in Colorado contain the only radium ores in the world which are being worked commercially.

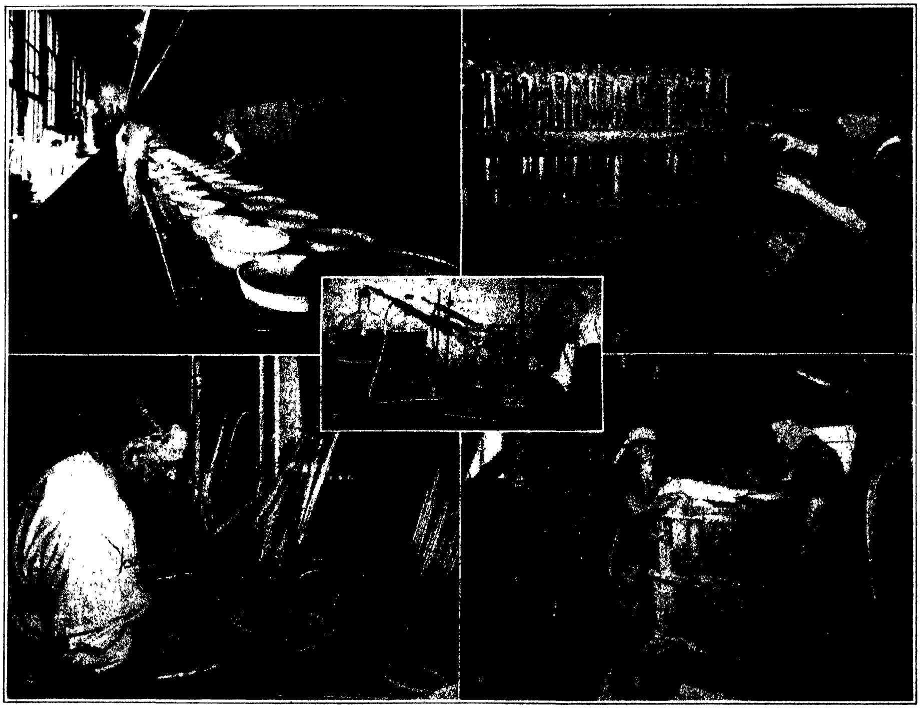
Before the war this country went to Europe for its radium. This was obtained from pitch blende which came from the lead and silver mines of St. Joachimstahl, Bohemia. While pitch blende contains from 30 to 70 per cent uranium oxide, from which the radium is extracted, it always occurs in small pockets in widely separated localities so that it is merely a by-product of other mining operations and no steady supply can be assured.

It is natural that pitch blende should have been the first source of radium as it was the power of a piece of this material to affect a photographic plate that first led the French scientist, Becquerel, and later others, to believe there was present some substance capable of emitting powerful and penetrating rays. To Mme. Curie, a Polish scientist, and to her French husband have gone the credit for isolating this substance.

The ore from which radium is now extracted is known as carnotite and occurs in relative abundance in Colorado and Utah where it follows generally an enormous geological fault which runs through this part of the country. The ore contains but from 1½ to 4 per cent uranium oxide, but once located, can be mined by ordinary shallow mining process.

The largest deposits so far discovered are in Paradox

(*Continued on page 320*)



1. No cook ever watched her pot more carefully than these chemists watch the "cooking" process going on in these pans, which contain half a million dollars' worth of radium. 2. One of the filter presses employed in the extraction of radium from carnotite ore. The solids are deposited in thick layers while the liquor passes through the filter press. 3. One of the several distillations that figure in the gradual elimination of all other elements save radium. 4. The radium reduction plant has its expert glass-blower, who makes the special apparatus required. 5. Vat containing vanadium, one of the principal by-products precipitated by chemical action

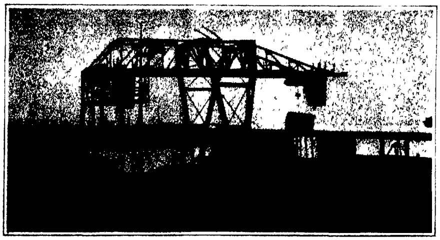
Some phases of the intricate process of reducing carnotite ore in order to obtain radium

Speeding Up the Unloading of Cars

IN any discussion of transportation problems the subject of loading and unloading always looms up big. In fact, more time and money are generally spent in loading and unloading the carriers than in the actual journey, through lack of proper facilities at the terminals.

Typical of the equipment which is now being installed by railroads with a view to speeding up the loading and unloading of their cars is the crane shown in the accompanying view. The crane travels on a pair of parallel rails laid along the wharf. On the transverse members of the crane are mounted two cars which carry their own control cages and hoists. These cars, traveling on independent overhead rails, can be operated quite independently of each other for the entire sweep of the transverse members. In this manner heavy loads, such as boilers, structural steel, large cases and crates, can be lifted off the cars on the barge alongside the wharf and placed on the motor truck, as shown in our illustration.

The crane is operated by electricity, the current being supplied by two overhead wires which are tapped by the two trolley poles which may be seen on top of the crane.



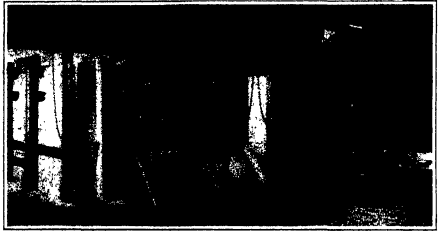
An electric crane with two hoists which speeds up the loading and unloading of freight cars

Steel Heat-Treating Furnaces with Flues in the Doors

THE heat treatment of steel has grown to astounding proportions, so much so that it is an industry by itself. A splendid example of this is shown by the accompanying illustration which portrays the heat treating furnaces in a large American steel automobile axle plant. A distinctive feature of these furnaces is that they have flues in the doors at the front to provide sufficient draft to bring the hot gases up to the doors and prevent cold spots in front of the doors. These flues, three in number, in each door, are 4½ inches outside diameter in the large furnaces and 3½ inches outside diameter in the smaller and extend up a distance of about 30 inches from about 2 inches above the furnace floor. In some of the furnaces the flues are built in the doors and others have a flue pipe in front of the door connecting with an elbow that extends through a hole near the bottom of the door. The flues can be equipped with dampers if desired.

Waste gas passes to the back of the furnace and around a coil through which the incoming air is delivered by the blower. This coil provides a preheating chamber for the blast. Back of the furnaces, which are arranged in a straight row at one side of the building in line with the interior building columns, is a concrete trench 4½ feet deep in which is located the oil lines and valve connections to the furnace.

The quenching tanks are located with their tops on the floor level directly in front of the furnaces. These have steel plate covers. In the case of the furnaces with hearths raised above the floor the covers are drawn over and rest at an angle against the front of the furnace, forming an incline on which work drawn from the chambers slides into a quenching tank.



Furnaces for the heat treatment of steel, with flues on the front doors to bring the hot gases up to the doors and prevent cold spots

Petroleum Products for Road Construction

A COMPLETE oil refinery, an experimental equipment for studying methods of treatment and characteristics of typical crude petroleum used in highway construction and maintenance, has been built by the United States Bureau of Public Roads at the Government experiment farm, Arlington, Va. A 70-gallon still, small steam boiler, super-steam heater, blowing kettle, condensing coils, air compressors, and a fuel oil heating system are the units which comprise Uncle Sam's refinery. Steam distillation is the method employed in determining the relative roadbuilding values of petroleums unearthed from the fields of California, Texas, and Mexico.

As fresh contribution to the study of bituminous materials, the preliminary tests as conducted in this experimental refinery have value in the application of results to highway construction and maintenance. The volume of petroleum asphalts, including road oils and flux, used for road-building purposes is of increasing expansion, the latest statistics indicating an annual consumption of 527,775 short tons of domestic petroleum and 650,244 short tons of Mexican petroleum, representing a total value of $17,759,224. Since coming into prominence in 1912, the petroleum obtained from Mexican fields has gained increasing favor as a product employed in building highways, while the use of domestic petroleum has decreased in consumption for this specific purpose in recent years. Hence, the significance of including the three types, gushing from wells in California, Texas, and Mexico, in the original investigations as undertaken at the Arlington Government farm.

Greater density of Mexican asphalts was proven by the tests. Asphalts up to 200 penetration produced from Mexican petroleum showed a specific gravity of 0.02 to 0.03 higher than that of California products. The difference is considered greater than is apparent in the figures inasmuch as a California asphalt of the same melting point is much harder at normal temperature than the output of Mexican oil fields. Steam was passed through the still at a rate calculated to maintain a constant ratio of water to oil distillate in the flow from the condenser.

Copyright, Harris & Ewing

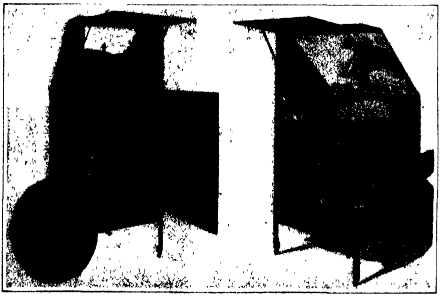
Experimental oil refinery built by U. S. Bureau of Public Roads in order to study petroleums

Motion Pictures Anywhere Without Operator or Screen

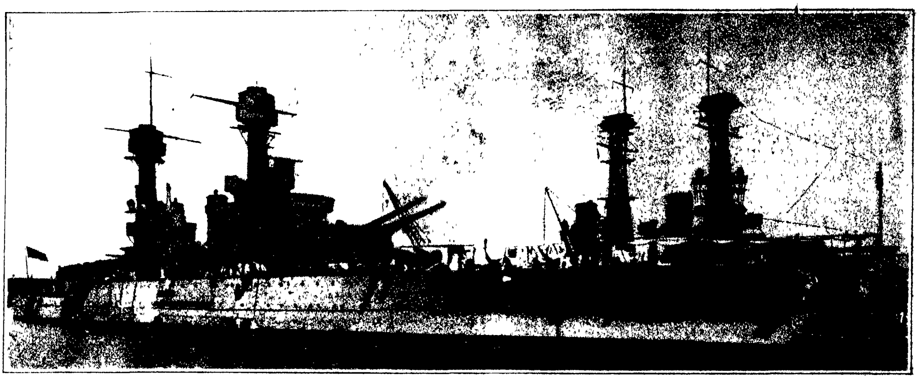
A MACHINE that transforms the motion picture into a simple and practical medium of expression for advertising, demonstration and education has been developed during late years to a state of real practicability. In brief, such a machine is automatic, it does not need an operator, it shows a continuous picture, it can be used in a lighted room.

The mechanism of the machine in question is quite simple. The film is placed in position, a button is pressed, and the projection begins and continues until the current is turned off. The mechanism is enclosed in a steel cabinet, the upper portion of which forms a shadow-box. Back in this shadow box is a screen, and on this screen is shown a motion picture about two feet square. Should a larger picture on a wall or screen be desired, it is merely necessary to open a door at the rear of the cabinet and project through this opening. It will be noted in the phantom view of the machine that a prism is included in the optical system so as to bend the rays at right angles from the lamp house.

The motion picture apparatus proper consists of an incandescent lamp, continuous and intermittent movements, revolving shutter and lens system. A small motor furnishes the driving power. The film is made in the form of a continuous belt by cementing its two ends together, and as much as 300 feet can be handled. The film is contained in a large circular magazine with the exception of a small loop passing through the projection apparatus. This arrangement permits of the continuous projection of the film without attention. A safety switch cuts off the electric current and stops the machine in case the film should break. The steel cabinet acts as a fire-proof booth, although this is not necessary when the "Safety Standard" or non-inflammable, non-explosive type of film is employed in contradistinction with the usual celluloid film such as is employed in the fire-proof booth of motion picture theaters.



Interior view of the advertising motion picture projector and a phantom view of how it works



Our latest battleship "Tennessee"; the first to be specifically designed for the electric drive

The Battleship and the Junk Heap

Is the Battleship Still the Backbone of the Fleet Or Is It Being Replaced by Other Craft?

By Lyne O. Battle

> *THE discussion which is raging over the question as to whether the battleship is "doomed" or not makes one think of the problem of the immovable post and the irresistible body. The trouble with the disputants is that each of them is given to exaggeration—overstatement of the arguments for his particular side of the controversy. The battleship is not doomed It is still the backbone of the fleet On the other hand, war beneath the water and in the air is coming along by leaps and bounds. Of this there can be no doubt whatever The battleship has been the foundation of the fleet from time immemorial It is the foundation of our modern fleets. Wisdom dictates that we should hold on to it; foresight demands that we shall recognize the increasing efficiency of the bomb and the torpedo. Whether the new modes of warfare are going to relegate the battleship to the junk heap is for the future to decide. To say that this has happened already is to beg the question.*—THE EDITOR.

OUR British cousins are between the devil and the deep blue sea over the question of scrapping their great battleships and preparing for future wars in the air or under the sea Its lines of communication are so vital to the British Empire that the discussion of the merits and demerits of the battleship have naturally aroused much interest in England

The heat of the discussion has been felt in America Our Navy Department has become so much interested that high ranking naval officers have been called upon to testify before the Naval Committees of Congress and the Naval General Board have made a report on the subject

The meat of the argument seems to be this: Friends of the all big gun-ship maintain that it is still the backbone of the fleet, and that, while the battle line needs numerous auxiliaries to protect it—such as battle cruisers light cruisers, destroyers and aircraft - the gun is still the principal weapon in sea warfare The enemies of the big ship claim that the battleship is doomed that with the same amount of money spent on submarines, torpedo-planes and bombers, the inordinately expensive dreadnaught will be driven from the seas

In the discussion on the other side of the Atlantic all hands, including even the opponents of the battleship are agreed that the capital ships of the grand fleet notwithstanding the fact that they were many miles from Dover Straits, made possible an uninterrupted line of men and supplies to war stricken France in default of which there is no doubt that Germany would have won the war

Ordinarily the armed forces of progressive powers profit by the lessons learned in past wars, and the main lessons from the Great World War seem to indicate plainly the gun as still the controlling factor as far as capital ships are concerned

Thus, British capital ships destroyed, or badly damaged during the war were as follows

(1)	By gunfire in fleet action	3
(2)	By torpedoes in fleet action	1
(3)	By mine	5
(4)	By submarines	5
(5)	By internal explosion	2
(6)	By torpedoes or bombs from aircraft	0

Now of the five ships that were victims of mines, two were lost at the Dardanelles where they were sent over the protest of the ranking naval officer at the British Admiralty, who knew it was contrary to a well recognized principle of naval warfare that ships cannot be used against shore fortifications nor can they be used in confined spaces where mine laying submarines have an opportunity to "lay their eggs" The other three were lost early in the war, before the paravane was perfected If, therefore the lessons of the last war are taken to heart, the mine should play a smaller part against the big ships in the future

Of the five capital ships sunk by submarines two were at the Dardanelles, confined, in a sense, to a small area thus offering the slow submerged craft an opportunity to attack them The other three battleships were torpedoed near Malta, in the English Channel, and near Gibraltar respectively it is not known whether they were screened by anti submarine craft when torpedoed, but it is known that *no* capital ships, cruising in fleet with a proper fleet screen, were lost

No remarks need be made concerning the two ships lost by internal explosion—the answer to that is a more stable, more carefully made powder

Taking out the five battleships lost by mines, the five lost by submarines, and the two by internal explosion, on the ground that a more expert knowledge of naval warfare should prevent these losses in the future, it can be easily seen that the war lessons point to the gun as the main factor of sea power

In any study of the question as to whether the big-gun ship is obsolete, attack on it from three planes must be considered: *i.e.*, surface attack, underwater attack and attack from the air.

1 *Surface Attack*—Students of naval affairs will remember that with the advent of the modern torpedo boat in the nineties, the disappearance of the battleship was predicted Progress answered, however, with the destroyer to drive off the torpedo-boat, and this was followed in turn by the fast cruiser to take care of the destroyer, and by the battle-cruiser to protect the van and rear of the battle line from the cruiser. The normal fleet then settled down to battleships, battle-cruisers, light cruisers and destroyers, and the fleet that could throw the most metal and hit with it, was the one that could win

2. *Underwater Attack*—Next came the submarine which some prophets say will play the main rôle in control of the sea in the future Now, looking again to the lessons learned in the war, not one capital ship in a properly screened fleet was damaged by a torpedo from a submarine during the whole course of the war One attack was made on the British Fleet by Wedigen, universally admitted to be the best man the Germans had at the time, but the submarine was rammed and sunk and the capital ships suffered no damage

The submarine is merely a weapon of opportunity If it happens to be ahead of a fleet, on its track, and is commanded by an iron-nerved skipper like Wedigen, then it may come within range and take its toll. If the sub is off the track of the fleet, however, its slow submerged speed, while running silently, will not permit it to gain attacking position If the submarine speeds up, the listening devices in the fleet screen will hear and warn the fleet, and all that the big ships need to do is to avoid that locality. Meanwhile the probabilities are that the fleet screen will get the submarine.

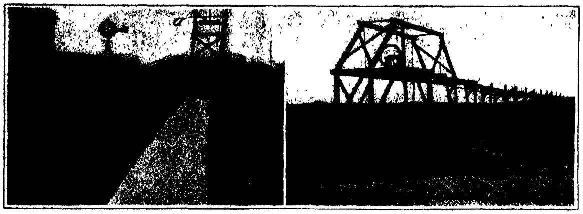
3. *Attack from the Air.*—The other plane from which the dreadnaught is to be destroyed is above water. Here the form of attack is to be by torpedoes or bombs launched from airplanes. This was never tried in the World War. It is reported that, recently, in England, a torpedo attack from airplane was made on a squadron of battleships. Five out of eight of the ships were hit with collapsible-head torpedoes. The fleet was at anchor and there was no battleship screen of destroyers firing at the planes which launched the torpedoes The fleet was not underway so that individual ships would have a chance, by a touch of the helm, to avoid the torpedoes seen in the water, as was done at Jutland.

We must bear in mind that in an airplane attack on a fleet with torpedoes, there are several difficult conditions to be met: (1) The plane must be only a

(*Continued on page 330*)

Why Not the Pit Silo?

WHERE climatic conditions, such as prevail in the Great Plains region, exercise a deteriorating influence on silos constructed of wood and the remoteness of farms renders almost prohibitive the transportation of material entering into the erection of masonry silos, subterranean containers for preserving ensilage are gaining favor. Pit silos are adaptable to the Panhandle of Texas, where the factors above-mentioned operate, superinduced by the cheapness of construction of underground storage-houses for the preservation of large quantities of cattle food.



Left: A pit silo with a combination hand hoist and hay carrier, the drum of the windlass being indicated at a. *Right:* Patented hoisting device by which the feeder can lift himself and the silage from the pit by an endless rope

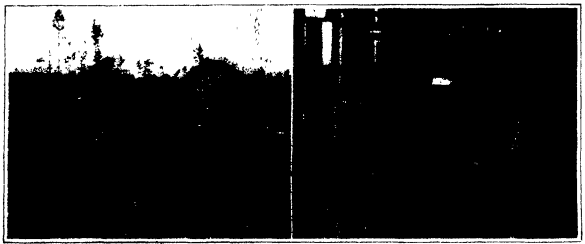
Two underground or pit silos and the machinery for handling their contents

While a pit silo is a "hole in the ground," it is something more if it meets the requirements of retaining the freshness of silage for stock during the winter months. As to soil, the usual specifications are: Firm land, well-drained, comparatively dry, and free from rocks and sand strata. Preliminary borings will determine the character of the soil, and the depth of the silo is gaged by the number of animals to be fed, the containers rarely exceeding 36 feet. A pit silo having an inside diameter of 15 feet is computed to be sufficient to winter 29 head of cattle, allowing 40 pounds to the head, or for 39 animals, allowing 30 pounds to the head.

The trench for the curb of the silo is marked off with a marker, the trench being 2 feet deep within these two outlined circles. The trench is 6 to 8 inches across the top. The inside wall is perpendicular and smooth, and the bottom level. The concrete put into the trench forms the curbing at the top of the silo. This curb of concrete will serve as a foundation upon which a light wall and a cover may be built. After the trench is completed it is filled with water, permitting the moisture to soak into the soil. The concrete is then placed, its composition being one part cement, two parts sand, four parts gravel, and the necessary quantity of water. Once the concrete constituting the curb has settled—three days having elapsed—the digging of the pit is begun.

The soil is displaced, the digging being straight down from the inside of the curb. It is imperative that the wall be perpendicular and smooth, otherwise (should the wall extend outward) a free air space conspires to spoil some of the silage. A plumb line is usually employed in keeping the wall plumb and smooth. If a carrier or track conveying silage away from the silo is a part of the equipment it is built before the pit is dug and is used in conveying soil when excavating the ensilage container. When five or six feet have been excavated the wall is plastered one inch thick with a mortar composed of one part cement and two parts clean sand. Two coats are essential, two hours intervening between the application of the first

(*Continued on page 320*)



Left. Yellow pine stump in Walton County, Florida, available for distillation. *Right:* Wood distillation plant, steam process connected with a sawmill for the conservation of sawdust

Converting stumps into turpentine, rosin and other valuable products

Distilling Pine Stumps

DISTILLATION plants located in North Carolina and Florida are converting pine stumps, discarded tree branches, chips and shavings into useful products. A study of the chemistry of yellow pine stumps indicates their possibility of conversion into as many as 26 different products—turpentine, charcoal, rosin, wood for pine oil, etc.

The stumps are transformed into salable articles both by dry and steam distillation of the popularly described "fat" or "light" wood. One company, recognizing the possibilities of utilizing stumps, is signing contracts for clearing the land. The cut-over areas in the South, expanding into millions of acres, are dotted with stumps. These are space-consuming as well as a hindrance to a widespread use of improved agricultural machinery.

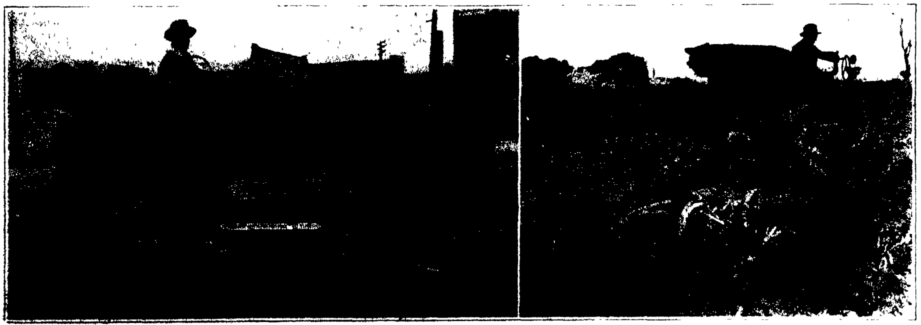
By converting the material into turpentine, rosin and other valuable products the expense of clearing the waste acres is considerably minimized. The stumps are cumbersome and heavy, having tap roots which penetrate deep into the soil. The cost of removal is considerable. Heretofore they have been a waste, even when uprooted as a whole.

A new process in distilling yellow pine products is being tried. One of the large automobile concerns is observing the developments with a view to utilization of stumps on cut-over lands.

Turning the Idle Automobile Into a Farm Tractor

THERE is nothing decidedly new in the idea of having the automobile serve as a farm tractor in its spare moments, but the fact remains that heretofore many of the attempts to this end have left much to be desired. Many such schemes have taken the form of a pair of heavy tractor wheels mounted on the rear of the automobile and driven through gears or chain transmission. The latest scheme in this field makes use of a special carriage or chassis on which the automobile is mounted. The rear wheels of the automobile are provided with sprockets which, operating in conjunction with chains, drive the large rear wheels of the carriage or chassis through reduction gearing. The wheels of the automobile serve as flywheels with this arrangement.

As will be noted in the accompanying illustrations and our cover picture, the car is run up on the carriage or chassis and held in place. The entire operation of placing the automobile and attaching the chains requires about five minutes. The tractor thus formed is steered by means of a vertical wheel on one side. A fan in front of the carriage or chassis supplies additional cooling capacity for the automobile radiator. The tractor by reason of its length and tread negotiates the hilliest, roughest ground with ease, according to the designers. In fact, so far as the service rendered is concerned, the machine is no make-shift.



Automobile mounted on special tractor chassis and ready to do service as an efficient farm tractor as shown in the second view

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGÉ, M S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Another instance of how a well converted motor-truck may be used for railway service, particularly on branch lines

Motor Trucks May Change Traffic on Short Line Railroads

THE Winchester and Western Railroad has recently installed a passenger service which is unique, and it is predicted by competent persons that it may revolutionize the passenger service on short line railroads This railroad is now operating from Winchester, Va, to Wardensville, W Va The car is a powerful gasoline motor truck It is equipped with a commodious body which seats thirty-four passengers comfortably, is well heated and electrically lighted This body is mounted on a 2½ ton motor truck, manufactured by a motor truck company of Wabash, Indiana The wheels are the same as on regular trucks, but instead of rubber tires, flanged iron tires are used, which are the same as those used for the pony wheels of the largest locomotives The rims are about one inch thick

The truck runs on schedule time, and is hauling almost capacity loads It arrives at Winchester at 9 55 A M and leaves at 3 P M Passengers are most enthusiastic over the new car, and prefer it to a regular passenger coach, there is no smoke, no dust, no cinders, and but very little noise The Winchester and Western Railroad has already announced a "theater special" run for the truck every Wednesday and Saturday evening, and the car will be available for special trips to town on any special occasion which may warrant it

New Double Dump Body

DURING the period of business depression now happily drawing to a close the engineers of a trailer manufacturing company have perfected and are now putting on the market a new two way side dump body constructed according to a combination of ideas of the engineers of various cities The peculiar conditions attached to ash, rubbish and garbage removal in municipalities have been given due consideration in the design of both trailer and body The combination of trailer and body is covered by patent We know that our readers will be interested in this trailer, as so far a lot of miscellaneous equipment has been put in operation for the purpose of garbage and ash hauling which as far as we can ascertain, has in no case been entirely successful The equipment described has been tested under the most severe conditions over a period of several months and it has stood up under the most extreme conditions

The outstanding features which cover, as far as we are able to ascertain, all the requirements of the city engineers in various cities might be briefly stated as follows First, low price, second, interchangeability of the trailer equipment with other bodies for other uses; third, simple construction in both trailer and body guaranteeing low rate of depreciation and long life, fourth, possibility of operating trailer and turning it around in narrow alleys fifth, simple body construction, assuring complete discharge of the load, sixth, loading edge from ground, 2½ yard body 59", 3¼-yard body 62" seventh, when body is dumped the lower edge of body clears the dumpage, eighth, body is under constant control of cables thereby eliminating the jumping off of the body from the trailer ninth, quick operation, as it takes only fifty seconds to raise the body to complete dumping position and after dumping the body returns to its horizontal position by gravity, *tenth*, light weight of the entire outfit in comparison with the usual drop frame construction, which will permit hauling by mules or horses as well as trucks

The double dump body as it is carried—low enough to permit ready loading, and in raised position for dumping

Wheels Require Inspection

FLEET owners naturally have among their drivers the good the bad and the indifferent And since expert supervision is, therefore, indispensable the service manager becomes responsible for keeping the equipment in first-class condition If he is a competent man, a large share of his time will go to motor truck inspection because this is the only way he can detect minor troubles in time to keep his machines out of the repair shop Even this service manager with all his mechanical knowledge, *often will overlook the wheels* The reason for this lapse is simple enough Barring accidents, this man may have handled motor trucks for years without a single wheel repairing job The very fact that wheels stand up so well causes him to take their good performance for granted and leave them out of his inspections just as instruction books on motor trucks leave them out of their list of necessary attentions

Other parts subjected to punishing duty demand expensive upkeep. Not so with wood wheels. All they ask is an occasional coat of paint to preserve the wood grain from the elements. If this small attention is given promptly when needed, the wheel will perform almost indefinitely *Occasionally the hub bolts* require setting up, a few minutes and a handy wrench is all that is necessary.

Rolling Fish Market Latest Commercial Vehicle

ONE of the reasons advanced for the high cost of food products is the number of steps necessary in transporting them between the source of supply and the ultimate consumer. If this is true, people in the vicinity of Atlantic City should be able to obtain their sea food at considerably less cost than people can who are not served by the rolling fish market illustrated in accompanying exterior view. This automobile fish market supplies fresh fish to various inland towns and uses Atlantic City as a headquarters and operating base The truck body has spacious show windows *and is provided with a refrigerating* system that keeps the fish in good condition A supply of over a ton of fish can be carried and five or more patrons can be waited on at a time inside of the commodious body The ideals of the modern shop keeper are carried out inasmuch as the store is clean, electrically lighted and equipped with modern computing scales and a cash register The extensive body sides permit the enterprising merchant to advertise his wares in an unmistakable manner and to proclaim to all who care to read that they operate their own fishing boats, bring the product directly from the producer to the consumer and as an added inducement they intimate that there is no middleman's profit though they do not go so far as to state whether or not the customer gets the benefit. The natural inference would be that communities served by this enterprising fish company not only procure sea food of good quality but obtain it at prices which make the enterprise mutually profitable This is an upkeep cue

A mobile fish market is the latest commercial body application

A New Form of Hydraulic Propulsion

(Continued from page 301)

through *A* divides and passes into the impeller through the unmasked portions of the holes in the sides of the drum This internal drum can be rotated about the impeller shaft by means of the lever shown and can be held in any desired position. When it is set as shown in the drawing, the orifice for the discharge stream is of maximum area and the pump is set for full speed ahead If the drum be rotated clockwise, the effective area of the discharge port and also of the inlet ports is reduced As a consequence, the volume of water handled by the impeller and the speed of the vessel is lessened. In the extreme position, as shown in dotted lines, the inlet ports and the outlet port are completely masked, the impeller merely churns the water inside the casing, and the engine is practically relieved of the load. Consequently, no mechanical clutch is required between the engine and the pump.

Now, let us suppose that the inner drum is rotated anti-clockwise from the position shown in the side view The effect is first to decrease the outlet orifice and throttle the discharge stream The continuation of the rotation results in the passageway *A* being increasingly opened by the orifice in the periphery of the drum, while the unmasked portions of the side orifice remain substantially constant in area In this condition a portion of the discharge stream is sent rearward and a portion forward through the passageway *A* If the movement be continued a point will be reached at which the momenta of the two portions are equal and the vessel will remain stationary, although the engine is running under full load Still further rotation will result in the entire discharge stream being delivered forwardly to *A*, when the propulsive equipment will immediately develop full speed astern.

Since the two pumps are controlled independently, one may be set full ahead and the other full astern, and the boat can be turned within its own length, in fact, the course of the vessel can be controlled by the pump only, if so desired In its investigation of this very interesting experimental boat, *The Engineer* found that the speed developed at 950 revolutions and 7¾ brake horsepower was 5 6 knots, and the calculations by Mr. Hotchkiss, the inventor, showed a jet efficiency of 73 per cent. He assumes the efficiency of the pumps at 90 per cent, and thus arrives at a propulsive efficiency of 65.7 per cent. Taking the engine efficiency at 75 per cent, the over-all efficiency works out at 49 8 per cent. This, *The Engineer* considers would be a fair showing in a vessel propelled by the old screw propeller, although our contemporary takes no responsibility for the data on which the calculation is based.

It should be mentioned that the pumps can be arranged to draw their supply of water from within the hull, in the event of the vessel being holed, and if the pumps are capable of handling in twelve seconds or so, as is claimed, a weight of water equal to the displacement of the vessel, they should be able to salvage a craft in which they were fitted, even though it was very seriously injured.

Germany's Brown Coal

(Continued from page 304)

From the driers the coal goes through pulverizers which reduce it to fairly uniform size; thence the powdered material is shifted mechanically to a cooling room, fitted with slanting floors or shelves over which it drops by gravitation; and at the bottom of the cooling chamber the lignite is in a condition to be handled by the briqueting presses to which it is led directly. The presses are of the open-mold plunger type, which subject the powdered brown coal, containing about 15

NEW BOOKS, ETC.

Personnel Administration Its Principles and Practice By Ordway Tead and Henry C Metcalf, Ph.D New York: McGraw-Hill Book Company, 1920. 8vo., 538 pp.

The fallacious but still dominant formula, that results are directly proportional to the power of enforcing obedience, fails to cover the complex relationship between managers and managed. We glimpse the fact that the quality of the obedience as determined by the mental reactions of the managed is overwhelmingly important—economically as well as sociologically, if indeed the two factors are ever sunderabe In "Personnel Administration" we find a sane balancing of these constituents, a comprehensive survey of the field, an evaluation of educational and health elements, specific research, the coördination of departments, and joint relations Vital topics are logically grouped and suggestively handled for the benefit of students executives and employers The best practice from innumerable sources is incorporated in the volume.

Direct-Current Motor and Generator Troubles By Theodore S Gandy and Elmer C Schacht, Lt J G, U.S N R.F New York: McGraw-Hill Book Company, 1920. 8vo; 274 pp.; illustrated

This is in the main a compilation of the simplest and most effective methods of tracing and correcting troubles, preceded by adequate descriptions of the various types of motors and generators, and their uses There is also an analysis, from the operator's standpoint, of problems centering about operation, care, and repair The illustrations are necessarily taken from standard machines, but the instruction is so given as to be general, and applicable to the operation of all types The question, 'What is the matter'' confronts the operator again and again, in giving a true, understandable answer, this handbook fills a daily need

American Machinists' Handbook and Dictionary of Shop Terms By Fred H Colvin and Frank A Stanley. New York: McGraw-Hill Book Company, 1920 16mo, 758 pp, illustrated.

Shop and draughting room are not immune from change, and this third edition of a work that is creating many friends for itself takes the changes into due consideration and adds much timely information Mathematics being the heart of mechanics, the tables and data here carefully selected and brought together, some of them from almost inaccessible sources, will soon pay for the elbow room they occupy, tools, processes and accepted practice are treated at length, shop and drawing room standards, horse-power, belts and shafting and shop trigonometry are presented in convenient arrangement, and the illustrated dictionary of terms is a valuable feature

Mechanical Drawing for High Schools A Text with Problem Layouts By Thomas E French and Carl L Svensen New York. McGraw-Hill Book Company, 1919 8vo, 221 pp; illustrated

In many ways this is an exceptionally good text, and will be recognized as such by the industrial educator More than the ordinary care has gone to teaching the best ways of using the drawing board and instruments shape visualization and description are rightly treated as of prime importance, other expositions include the technic of the finished drawing, mechanical and architectural practice, and graphic solutions and sheet-metal drafting Eighty pages of problems cover all phases of the study, and the instructions are amply illustrated

Human and Industrial Efficiency. By Henry Chellew, Ph D., D Sc. Preface by Rt Hon Lord Sydenham, F R.S New York and London G P Putnam's Sons, 1920 12mo, 149 pp

This short study of the factors of efficiency recognizes two fatigues, 'and the most important is that of the mind" Lord Sydenham, in his preface, lays unrest at the door of our neglect of the psychological requirements of the human machine, and the author, whose instruction at the University of London will be remembered by many American officers, writes as practical philosopher rather than as engineer His synthetic study gives brief glimpses of the broad field, and is but the forerunner of a projected volume that will deal more exhaustively with vocational adaptation and training.

Motor Query Encyclopedia Cincinnati: American Automobile Digest, 1919 16mo; 129 pp., 160 illustrations

A very large proportion of our people are practically interested in motors. Questions as to cause and effect are continually arising in their minds The chances are that you will find your pressing question of the moment formulated in this little handbook, and answered to your full satisfaction. Axles, batteries, chassis, clutches, cooling, lighting, ignition, steering gear, transmission—in short, everything about the car is explained in brief, simply worded paragraphs.

Hydraulic Tables By Gardner S. Williams, M Am Soc C E and Allen Hazen, M Am Soc C E New York: John Wiley and Sons, 1920 8vo, 115 pp.; illustrated

These important tables, accompanied by brief explanations, deal with gagings, the friction of water flowing in pipes, sewers, etc, as determined by the Williams Hazen formula, and the flow of water over sharp-edged and irregular weirs and the quantity discharged There is a new chapter of additional data in this third edition, and a graph showing the relations of the chief results both new and old These tables have proved their value in fifteen years of use

Mexico in Revolution By V Blasco Ibañez Translated by Arthur Livingston and José Padin. New York E P Dutton and Company, 1920. 8vo.; 245 pages

Ibañez, caught in the "vertiginous" storm of a Mexican revolution, tells us how it all came about These articles first appeared in American newspapers, and they constitute a chatty, keen account in which Mexican society, character, and politics parade before the edified reader Bonillas, Obregon and Gonzalez are drawn with a sure hand, the condition of the country is set nakedly before us, and in the final chapter, on Mexico's attitude toward the United States, amusing and serious elements mix to define a situation of which we should all have more knowledge

A Manual of the Timbers of the World By Alexander L Howard New York The Macmillan Company, 1920 8vo., 446 pp, 100 illustrations

This notable handbook is intended to supplement rather than to supersede other works The characteristics and uses of all commercial timbers are alphabetically catalogued, pictured, and described Other material includes the conversion and preservation of timber, specifications and conditions of contract, Laslett's tables, a classification of timbers according to the country of origin, and a bibliography The section by S Fitzgerald on artificial seasoning, is a noteworthy feature, and there is an index to scientific names in addition to the general index

Surface Water Supply of the United States 1917 Part I North Atlantic Slope Drainage Basins Washington Government Printing Office, 1920 8vo, 200 pp, 2 plates

Data collected by the Geological Survey during 1917 and presenting results of measurements of flow made on streams, occupy 14 reports, of which this is one It describes the typical gaging station and its equipment and tabulates the records of the North Atlantic Slope

American Lubricants From the Standpoint of the Consumer By L B Lockhart Easton, Pa The Chemical Publishing Company, 1920 8vo, 341 pp, illustrated

The difference between this and most other books on lubrication is indicated in the subtitle, the user's interests are made paramount, and the buyer and consumer of oils and greases is taught to select intelligently those best suited to his purposes From crude petroleum to its refined products, characteristics and properties are described, solid and fluid friction and the lubricants and systems dealing with them are discussed, following this come chapters on the demands of special machinery, from the internal combustion engine to the steam railway Mills and plants of all kinds are considered, and tests, analyses, and up to date specifications are dealt with at great length Important tables conclude the informing and helpful work

The Colonization of North America 1492-1783 By Herbert Eugene Bolton, Ph D and Thomas Maitland Marshall, Ph D New York: The Macmillan Company, 1920 8vo, 600 pp, 49 maps

Eastern insularity may be to blame however that may be, it is a fact that most of our works on colonization are devoted to the thirteen English colonies, slighting France, dismissing Spain with a word, and largely ignoring Holland, Sweden, Russia and Denmark The substantial volume in hand corrects this narrow viewpoint and brings local developments together as integral parts of a complete picture It rehearses the whole drama of civilization in North America, with strict attention to time sequence and the comparative importance of racial activities. This breadth of treatment is commendable, and readers will gain from it an expanded consciousness of the multiplex factors that left us what we were at the close of the Revolutionary War

Fuel Oil in Industry By Stephen O Andros, A B., E M Chicago. The Shaw Publishing Company, 1920 8vo; 244 pp, illustrated

The principles of fuel oil combustion and its physical and chemical properties are here outlined in a highly satisfactory manner There is a comparison of coal and oil fuel, a chapter on colloidal fuel, and a long and valuable discourse on distribution and storage Other chapters treat of heating and pumping, boiler furnaces, fuel oil burners fuel oil in steam navigation, locomotives, iron and steel manufacture, the production of electricity in the sugar, glass, and ceramic industries, the heating of buildings, and the making of gas The publication is timely, the theme well handled, and the appeal wide

A Course in Practical Mathematics By F M Saxelby, M Sc, B A New York and London Longmans, Green and Company, 1917 8vo, 472 pp, illustrated

This thorough course takes cognizance of the needs of the technical student The deductive treatment is accompanied at every step by graphic or arithmetical verification, the arbitrary system of symbols is illuminated by the facts of experience Thus the mind is gradually prepared for the analytical methods of differentiation, and trigonometry is made comprehensible to the earnest student The same method is extended to the mastery of definite integration, and the best educational order of subjects is followed, rather than the merely logical or historical order

The Ceramic Industries Pocket Book By Alfred B Searle New York Isaac Pitman and Sons, 1920 16mo; 267 pp, illustrated

From various sources this manual takes information that has been of practical assistance to those engaged in the clay working, glass, and allied industries, and arranges it in convenient form It describes materials, gives data on water and steam, briefly treats of mechanics and dynamics, gives pertinent facts relating to machinery and burning and kilns, and presents ceramic calculations A bibliography and a list of technical and other associations round out a handbook of high value to students and workers

Dictionary of Explosives By Arthur Marshall Philadelphia P Blakiston's Son and Company, 1920 8vo, 159 pp

Those who are acquainted with Mr Marshall's authoritative works on explosives will be glad to note this up-to-date dictionary, which replaces old books of a similar nature Very little is included beyond explosives with special or proprietary names, so that practicality is assured We find those used in British, American and European coal mines, in blasting in shells bombs shotguns and rifled firearms descriptions and formulas are given, and there is an index of constituents

A Text-Book of Physics By Louis Bevier Spinney New York The Macmillan Company, 1920 8vo, 617 pp, illustrated

Professor Spinney has taken pains to make the fundamental subject of mechanics as interesting and understandable as possible to the college student Heat electricity sound and light are so presented as to include descriptions of all experimental laws and phenomena that directly contribute to a logical development of general physics without becoming digressive A knowledge of algebra, geometry, and the trigonometrical functions is assumed, practical aspects are emphasized, illustrations use mainly familiar phenomena, and principles are exemplified by investigating their applications

A Guide to the Military History of the World War 1914-1918 By Thomas G Frothingham, Captain U S R Boston Little, Brown and Company, 1920

It is exceedingly difficult to find within a year or two after a war, a history of the conflict treating events in their proportional importance, or with anything like a true perspective Yet the consensus of military opinion seems to be that Capt Frothingham has accomplished this feat His narrative synopsis covers the strategy and grand tactics of the whole war Students and the general reader should find the outline invaluable as a check against the misleading tendency of phase study and as a guide in forming a clearcut orderly conception of the wave action of the forces employed The author's analysis of the battle of Jutland is a striking instance of his critical, descriptive and deductive powers

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

GARMENT FASTENER.—B A SHAMMO, 106 W 79th St, New York, N Y. This invention has for its object to provide a construction which may be easily attached to the garment and which in operation will properly hold the garment while permitting easy engagement or disengagement. A further object is to provide a fastener in which a bridge and interlocking tongue are used and giving the finished appearance of a rounded button.

SHOE FASTENER.—B A SHAMMO, 106 W 79th St, New York, N Y. This invention relates to a fastening device which is especially adapted for use with shoes. An object is to provide a fastener wherein a proper clasping action is secured when first used, and means are presented which will permit a readjustment of the parts to maintain a desired position of the garment fastened, and which will thereby automatically take up any stretching or distending of the material of the article.

Electrical Devices

SWITCH FOR FLASH LIGHTS.—H M KORETSKY, c/o Bright Star Battery Co, 310 Hudson St, New York, N Y. More particularly the invention relates to a switch for intermittently or continuously closing the circuit of the battery and lamp. The general object is to provide a combination of push button and slide button so arranged that they are employed independently for closing the circuit by engagement with the contact strip within the casing of the flash light.

STORAGE BATTERY.—P M MARKO, 1191 Bedford Ave, Brooklyn, N Y. The invention has for its general object to provide a form of jar cover which permits of the level of the electrolyte to be easily and quickly ascertained without removing the vent or filling plug; this is accomplished by the making of the cover of transparent pressed glass of special design, and within the cell are two distinctly colored arrows attached to the terminal posts, which serve as means for determining the proper level of the electrolyte.

ELECTRIC SWITCH.—A M CONDIT, 19 Essex St, East Orange, N J. The object of the invention is to provide an electric switch arranged to permit of conveniently closing an electric circuit temporarily or for any length of time according to the desires of the user and without requiring his attention for the time being. Another object is to permit of conveniently attaching the switch to a desired support on an automobile for use in signaling devices to enable the operator to control the display signals.

BLASTING APPARATUS.—S I HOAR, 2216 Cottonwood St, Meaderville, Mont. The invention relates to electrical apparatus for use in blasting, and has particular reference to a switch adapted for closing a number of circuits for exploding electric primers. A further object is to provide an explosive charge which may be completely assembled before being distributed to the miner, so that all the miner need do is to place the same in the hole to be blasted and connect it in the circuit.

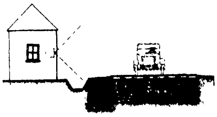
ELECTRIC LIGHT FIXTURE.—B B STENSVALL, 521 45th St, Brooklyn, N Y. The invention has for its object to provide a fixture of the type generally employed on a desk, the important features residing in means for variously adjusting the light, novel supporting means and the manner of arranging the conductor cord with respect to the adjustable and supporting elements, whereby the light may be employed as an effective and convenient searchlight.

Of General Interest

GARMENT HANGER.—M ROSENTHAL, 501 W 170th St, New York, N Y. Among the objects of the invention is to provide a garment hanger which in addition to supporting a coat, or similar article, is capable of supporting a plurality of other garments and also has the advantage of having the supports for the other garments removably attached. The device may be formed of wood or metal, and either rigid, or foldable for convenience of travelers.

STONE MOUNTING.—A L ELIASOFF and C BIRNBAUM, 80 Nassau St, New York, N Y. The invention relates to jewelry and more particularly to ornamental gem settings. An object is to produce a stone setting having a light reflecting medium which adds to the charm and luster, and also provides means for securely anchoring a precious stone in the prongs of a ring, the prongs being protected from wear, thus decreasing the possibility of the loss of the stone.

TRAFFIC REGISTER.—G HENRY, 55 d'Artigny St, Quebec, Canada. It is the purpose of this invention to provide a sytematic, automatic and continuous registration of the actual traffic at any point on a highway. The object being to provide an apparatus which will take an instantaneous photograph of traffic on a street or road so that vehicles of all speeds can be photographed as they pass a given point in such form that the film may later be used as a permanent record in connection with a projecting device.



A VIEW IN SECTION, SHOWING A VEHICLE PASSING THE POINT OF OPERATOR

ARTIFICIAL LIMB.—J W SMITH, 1621 Francisco Ave, Chicago, Ill. It is one of the objects of this invention to provide an artificial arm which is capable of use in cases where the natural arm has been amputated either between the shoulder and elbow or between the elbow and the wrist. A further object is to construct an artificial arm in such manner that the forearm section is movable with relation to the upper arm section, the hand section universally movable with respect to the forearm, and the finger sections movable with respect to the body portion of the hand, the finger sections having means to cause them to grip articles of various sizes.

MOVING PICTURE CAMERA AND PROJECTOR.—D FATIRNOPOULOS, 67 Cherry St, New York, N Y. An object of the invention is to provide means wherein the parts may be quickly and easily adjusted or rearranged to act as a camera or as a projecting machine. A further object is to provide a simplified and small construction for family use, the structure being such that a minimum of space will be required for its use.

SNAP ORNAMENT FASTENER.—N BANTOFT, address L M Friedman, 238 Broadway, New York, N Y. The invention relates to an ornamental stud or button. An object is to provide a snap fastener which is adapted for use as an ornament or as a fastening means for a garment, and which permits the removal of the stud during the laundering operation of the garment so that the ornamental exterior of the fastener will not be broken or injured.

CONCENTRATING TABLE.—J F McNEIL, Death Valley, Cal. In order to obtain a larger proportion of concentrates and increase the capacity of the table with minimum power, this patentee arranges a series of oblique riffles inclining upwardly toward the high side of the table and adjacent to the opposite side, or tailing discharge, are riffles parallel with the axis of the table. Between the two series of riffles is a bank riffle the top surface of which slopes toward the tailing side, all the riffles being gradually of reduced height toward the discharge end of the table. A feed device extends across the oblique riffles and there is essentially a feeding to all the riffles adjacent the head of the table. The bank riffle results in a pond being formed at the area of the oblique riffles. The material is required to travel upward toward the high side of the table before escaping to the table surface to be carried laterally toward the parallel riffles.

PLAN VIEW OF THE TABLE

DEVICE FOR USE IN LEARNING TO SWIM.—G. JORDAHN, Palm Beach, Fla. The invention relates more particularly to an inflatable device adapted to encircle the body and to be positioned in such manner as to preclude accidental displacement. The device is provided with means for readily tying the ends of the tube, which tying serves the double function of retaining air in the tube and properly holding the tube around the body.

CLOTHESLINE CLAMP.—W A. JOHNSON, 202 Quincy St, Fairmont, W Va. Among the objects of this invention is to provide a simple, inexpensive and efficient metal hook and eye clamp which will effect a locking of the clothes line to the prop so that accidental displacement of the line is positively prevented; the only way in which the line can be removed from the clamp is by manually removing the eye from the hook.

CONTAINER FOR CEDAR SHAVINGS.—J E TRACY, Box 830, Orlando, Fla. The invention relates to a comparatively small box which may be placed in a trunk or clothes closet for preventing moths from attacking the clothes. The purpose is to provide a container which will allow of the exposing of cedar shavings to the air at the same time preventing the shavings from being displaced.

STORE SIGN.—B H SCHARE, 635 W 170th St, New York, N Y. An object of the invention is to provide a sign with a changeable display to be mounted on the door and readable through the glass of a store door or other institution having public patronage to announce whether or not the store is open or closed, and to further announce good will and a spirit of welcomeness to customers entering and leaving.

HUMIDIFIER.—L A SMITH, Port Gibson, Mississippi. *This invention has for its object* to provide a small portable humidifier capable of being carried in the pocket if desired by means of which a cigar may be simultaneously moistened and impregnated with a flavoring by drawing a blast of air laden with the flavoring through the cigar.

Hardware and Tools

RAZOR.—D A FENWICK, Box *222*, Bisbee, Arizona. The invention relates more particularly to a razor having a removable double edged blade supported in a holder or frame which has the general appearance of and operates in the same way as the ordinary old style razor. An object is to provide means for securing the razor in the holder and permitting the use of a thin steel double edged blade which can be sharpened on an ordinary strop and cheaply manufactured.

CURTAIN ADJUSTER.—F M MENZL, cor Riker and Steinway Ave, Steinway, Long Island City, N Y. Among the objects of the invention is to provide a neat and inconspicuous cross bar, which when in operation will hold a lace curtain well spaced from the window sashes so as to afford a free flow of ventilation, and prevent the blowing of the curtain or the soiling thereof and permit unobstructed cleaning of the window and other purposes.

COMBINATION SCALE JACK.—C D STEELE, 59 W 44th St, New York, N Y. The invention relates to a device such for example as lifting jacks and weighing or load indicating devices. Among the objects is to provide a relatively simple implement easily manipulated by any ordinary person for the purpose of checking the weight of loads such as coal, grain or hay, when carried either on horse-drawn or self propelled vehicles.

We wish *to call attention* to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical or scientific knowledge required therefor.

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per cent of moisture, to a pressure of from 18,000 to 22,600 pounds per square inch. The briquets are lozenge-shaped, 7 inches long, and 2¼ inches wide, weighing 1 pound each. No binder is required because the heat of compression liberates from the lignite sufficient tarry matter to insure adhesion. Each press has a capacity of 77 short tons of briquets during a 24-hour run; and 120 horsepower are required for its operation.

Because the briquets are very hot when first molded, it is necessary to cool them to guard against ignition if they be piled immediately. Therefore, they drop from each press into a trough-shaped conveyor which moves the briquets to the storage sheds; and this journey of 325 feet is long enough to chill them sufficiently.

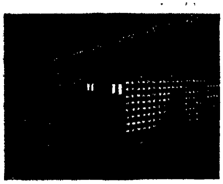
Shortly before the war a large central power station for the generation of electricity was placed at a brown-coal mine in the Cologne district, and was able to furnish current to that city at the rate of about ¾ cent per kilowatt hour. Two years ago Mr. George S. Rice of the Bureau of Mines was in that neighborhood, and at the Fortuna mine he visited a central station which was developing 40,000 electrical horsepower and transmitting that energy to Cologne 12 miles away. Such of the brown coal as was not burned under the boilers was being made into briquets, which were used in competition with bituminous coal both on the railways and for factory and domestic use.

It has been proved by the Germans that boilers can be constructed that will work well when fired with either hard-coal or brown-coal briquets. It seems that the heating value of either fuel is substantially the same for continuous operation. Brown-coal briquets, however, are less suitable for intermittent service. A well-known German engineering concern has recently developed a special boiler for the use of brown-coal briquets and even inferior grades of fuel, and the tests have been highly satisfactory. The efficiency is reported to have run between 78 and 84.2 per cent.

How great this industry is can be readily grasped from the following comparative figures: In 1913 the brown coal output totaled 79,741,825 tons, and last year it aggregated 121,202,215 tons. Relatively 5 per cent less of the lignite production was worked into briquets during 1920 and this probably indicates not only the wider direct burning of the raw brown coal for the development of power but gives us an inkling of that other line of activity which is engrossing many of the best technical minds of Germany—the dry distillation of this low-grade fuel, in which notable results have been achieved.

Not quite a year ago the German Government determined to regulate the coal-tar trade, and called into being the "Economic Union for Crude Coal Tar and Coal-Tar Products." Prior to the war Germany obtained, in round figures, 380,000 tons of tar oil from coal; and her lignites yielded about 47,000 tons of paraffin oil, gas oil, etc. In 1919 there was produced from coal substantially 300,000 tons of tar oils, but, according to the Treaty of Versailles, Germany must deliver annually, for a period of three years, no less than 35,000 tons of benzol and 50,000 tons of coal tar or products distilled therefrom. Naturally, stripped as the Teutons are of so much of their black coal region, they must make the most of the native lignites in order to meet their own wants and to satisfy the terms of peace. It is estimated that 50,000 tons of tar oils were distilled from brown coal in 1920.

War-time experiments revealed that the distillation of lignites, at high temperature, would give a liquid coal tar which contains certain ingredients that could be substituted for gasoline, kerosene and lubricating oils. Through a later process it is possible to get benzine and kerosene from coal tar distilled from brown coal at a lower temperature; and by reason of this development all industries that can do so are being urged to provide them-



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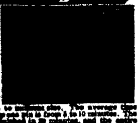

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selves with facilities for this purpose. To this end, the authorities have put a premium upon the distillation of lignites by promising to remit the coal tax in the case of the brown coal so treated

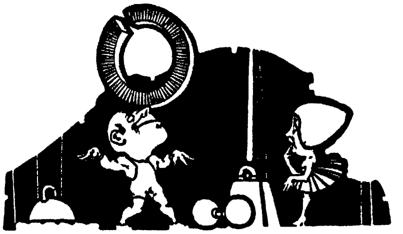
About a year back a German technicist stated, in making an address before the Prussian Ministry of Public Works, that one ton of brown coal would yield enough gas to generate 408 kilowatt hours of electricity, and provide in addition 77 pounds of tar, 8.8 pounds of pitch, 8.8 pounds of paraffin, 8.8 pounds of "solid oil," and 22 pounds each of two other kinds of industrial oils At that time the expert said that a method had been discovered by which edible fats, suitable for the manufacture of margarine, could be derived from this coal tar, and it seems that soap has been made from the same source.

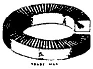
Another consequence of the peace treaty is Germany's obligation to give to France each twelvemonth also for three years 30,000 tons of ammonia, and here, again, brown coal comes to the rescue. While this discovery of industrial salvation is heralded as another proof of Teuton technical cunning, it serves the while to confirm independent work done on this side of the Atlantic by some of our own people even before the World War It was found here that from the distillation of lignite it would be practicable to realize approximately 17.4 pounds of ammonium sulphate per ton of the dried fuel, and the Germans are turning this fact to good account in the treatment that they have adopted

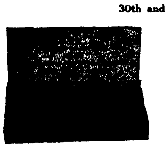
It is now well known that lignite, if carbonized at the relatively low temperature of about 1,200 degrees Fahrenheit, will give off gas freely, and that the byproducts recovered will be of satisfactory quality Above that temperature the destructive distillation of the tar in the raw fuel begins, and the greater heat not only reduces the amount of recoverable tar but affects the character of that material and the oils that may be subsequently obtained from it It has been established that heavy oils from lignite tar are admirably suited for use in internal combustion engines because the oil does not deposit tarry matter And what is of equal significance, lignite gas is what is termed a "dry" gas—*i e*, it is substantially free from tar, and gives no troublesome condensation when distributed through slightly protected pipes even in cold weather The gas is well adapted to power purposes

Probably one of the most interesting phases of the dry distillation of brown coal or lignite is that the carbonized residue, of very little value in the form in which it comes from the retort, may nevertheless, be converted into a really excellent smokeless fuel by briqueting. Indeed, briquets of this nature are distinctly superior to those made from dried brown coal. Comparative tests with high-grade bituminous coal have shown carbonized lignite briquets to be more efficient. For instance, 3.76 pounds of briquets and 3.88 pounds of soft coal were severally required to develop a horsepower hour, the quantity of water evaporated per pound of fuel was, in the case of the briquets, 9.18 against 8.88 pounds on the part of the bituminous coal; and the average boiler horsepower developed was 98 with the soft coal and 101.5 with the briquets

It should be kept in mind that, by exhaustive distillation and treatment of the tars and oils, it is practicable to derive hundreds of synthetic products, such as paraffin, acids, antiseptics, photographic chemicals, aniline dyes, drugs, perfumes, preservatives, etc. From the light oils can be got benzol, tolnol, dyes, photochemicals, certain drugs, etc. From the carbolic and creosote fractions are obtained carbolic acid, creosote, picric acid, photodyes, coloring materials, perfumes, etc. The anthracene oils yield, among other things, alizarin, valuable acid used in the production of dyes, and carbolineum, effective as a wood preservative.







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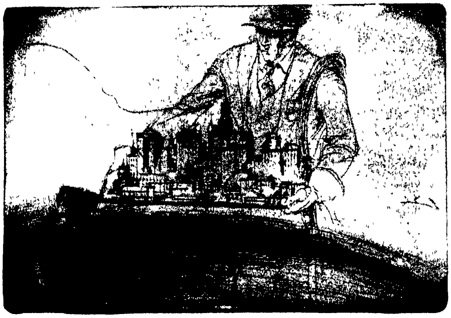

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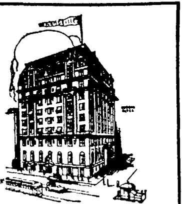

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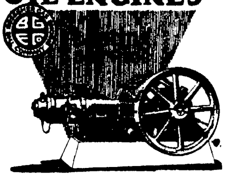

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From Brewing Beer to Raising Mushrooms

(*Continued from page 305*)

vated mushrooms to similar conditions. After the beds are planted and allowed to germinate, they are wetted down not as by a shower, but by the better method of producing in the room a heavy fog. This is done by the use of steam and the refrigerating apparatus For a time there is maintained a fog so dense that one can hardly see one's hand held at arm's length When the beds have reached the proper degree of saturation the air is cleared within a few minutes and a slow drying process begins It is during the drying out that the mushroom growth takes place Appearing within a few hours as little white balls, they grow steadily until within a week they are "ripe"

A mushroom is ripe, it is explained, when the delicate skin or membrane on the under surface is still unbroken, but gives to a slight pressure of the thumb. If the membrane which protects the "gills" is already broken the mushroom is overripe and decay will begin very soon

Carrying still further the idea of reproducing the atmosphere of a thunder storm, a large static machine was obtained and continual discharges of artificial "lightning" were produced during the period of growth. The subtle change this produced in the atmosphere was found to have a very marked effect on speed of growth and size of the product Since the power required to operate the static machine was very small and the results quite noticeable, the machine will be made a permanent part of the equipment.

There is probably no fruit or vegetable which deteriorates so rapidly after picking as does the mushroom Most of the cultivated mushrooms offered on the market, are, under the best of conditions, from three to four days old By that time they have lost considerable weight and, according to connoisseurs, much of their delicate flavor.

The sales plan of the new "plantation" contemplates having the mushrooms served within three or four hours of the time they are picked. So far the large New York hotels have taken the entire production and even the demand from this source could not be met Several of the New York hotels use a hundred pounds of mushrooms a day No customer is allowed to order more than he can use in a single day and deliveries are made every day within an hour or two after picking.

Testing Roadbed Conditions by the Resistance Method

(*Continued from page 305*)

current of from 25 to 35 amperes The current entering the rails flowed away from the test station in both directions, leakage taking place to the earth and the current was picked up by the water-piping system and returned to the negative pole of the battery A milli-voltmeter was used in measuring the loss of current between two stations, several thousand feet apart

Roadbeds having a foundation of clean, crushed stone under a concrete paving base offer a higher resistance than structures with a solid concrete ballast Trackage with a full crushed stone ballast and a Tarvia finish offers a high leakage resistance, which is of the order of 2 to 5 ohms for 1,000 feet of track. Where the ties are buried, insuring a moist condition, resistance is lower than that of open-construction roadbeds, being from 1 to 1.5 ohms for 1,000 feet of single track The theory that open-construction track is insulated from the earth is not supported by facts Zinc chloride and other chemical salts used as preservatives render ties highly conducting and increase leakage currents from the tracks.

Summarizing the moral that these investigations would teach the Bureau of Standards, offers some suggestions to elec-

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tric railway companies for minimizing the leaking of currents from trackage. Abandon solid concrete ballast, substituting crushed stone as foundation under ties; when using crushed stone or gravel protect it with coverings or pavement; use of salt as an antifreezing remedy on switches should be avoided inasmuch as it reduces the resistance of roadbeds; rails, bored by open construction, should be removed from contact with earth.

Solving the Labor Problem—V

(Continued from page 306)

$80 to $300, or even more, in training a man to do one's work acceptably it is obviously not good policy to allow that investment to be jeopardized by the unrestrained vagaries of a temperamental foreman or higher officer

So there is a growing tendency to restrict the powers of the foreman who, so far as the average employee is concerned, personifies the company. Workmen are hired by the Employment Director and his staff of urbane interviewers Separating the sheep from the goats in the horde of applicants is only the preliminary task of the Employment Director Having controlled the sheep it is his duty to see that their first impression of the plant is a favorable one and thereafter to see that the first impression is strengthened. Human nature is the same the world over Many a promising prospect for a shop that needed him has been lost because the prospect did not approve of the foreman's manner of receiving him on the first day

The foreman can no longer discharge a man without the advice and consent of the Employment Director unless for some peculiarly flagrant transgression Neither are old-fashioned driving methods permitted to the foreman Getting things done is now recognized as an art which calls for the exercise of diplomacy and a broad understanding of human nature, among other things

Foremen are the raw material from which higher executives are fashioned Once the upward climb has begun further training is found to be a prerequisite to promotion, so that he who seeks a career in industry or commerce must look forward to a continuous round of training which will end only when he is retired under the age limit

If the anticipations of the National Association of Corporation Training are realized the third stage will be ushered in with the establishment of a great university under its auspices This new type of university will offer no academic nor engineering courses, but will devote itself wholly to research in industry and commerce and to training men for careers in these fields or to go into colleges as instructors for the business army of tomorrow

Preventing the Roll of Ships

(Continued from page 308)

The power consumed in running the heavy gyroscope is inconsiderable, partly because the runner spins in a vacuum Data have been accumulated from the service performance of a fast passenger and cargo ship running over the same course in the same direction for ten consecutive trips of 4,600 miles each. Information has been made available in respect to the retardation due to variations in the weather. Using this as a basis, it is estimated that if the daily operation of 24 hours means an outlay of $6,000, then "the extra expense—that is, the expense over and above the average—in the stormy months amounts to not far from $100,000. This, taken with the amount saved through elimination of bilge keel losses, develops an earning capacity on the cost of the stabilizer of not far from 100 per cent per annum."

There is seen to be a great advantage in connection with the use of the stabilizer, when one perceives that the ship may be kept on her course, in beam seas, with unchecked speed when storm condi-

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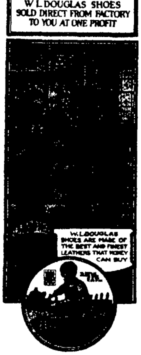
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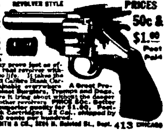

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Occupation

tions intervene. It is understood that stabilized ships are able more closely to approximate the regular schedule, despite the occurrence of storms.

Bilge keels on vessels are useful when the ship is undergoing very heavy rolling. At other times, they are a disadvantage, since they effect retardation. Even when the weather is calm, the bilge keels retard the ship by skin friction. In bad weather, when the ship pitches, there are considerable displacements of water as the vessel pushes on. For the "Campania," a ship of 19,400 tons, the calm weather loss has been put at 840 horsepower, and the rough weather loss at 1,440 horsepower. It will be gathered that bilge keels are rather expensive, but they are ordinarily needed in very bad weather. If, however, the ship is equipped with a suitable stabilizing plant, the bilge keels may be omitted, since under these circumstances their occasional service—that is, during bad rolling—is much better performed by the gyroscope.

Cargo, as well as passenger, vessels are benefited with respect to the better care it is possible to take of the load being carried. When live stock is being transported, the advantage is almost obvious. A concern engaged in shipping horses during the Great War had losses running up to $30,00 or $40,000 in single trips. Such losses occur because of the bad rolling in heavy storms.

Finding Jobs for Radium

(Continued from page 310)

Valley, Colorado, more than fifty miles from the nearest railroad over a barren desert trail. It is a natural conclusion that the extraction plant would be located at the mines under such circumstances but such is not the case. The largest producer of radium carries the ore clear across the continent and extracts the radium in a plant at Orange, New Jersey. The reason is that for every ton of ore extracted, tons of chemicals and coal are required, and it is cheaper to move the ore to the chemicals than to move the chemicals to the ore.

The extraction process consists simply of eliminating the various substances in the ore until finally the radium alone is left. A ton of good ore contains approximately five milligrams of radium. A milligram is 1/1000 part of a gram and a gram is about 1/28 of an ounce. To obtain this tiny bit of material the ore is first ground and then put through scores of chemical elimination processes. It is mixed with other chemicals, allowed to settle in big vats, and passed through many strainers. The final processes are carried out in the laboratory under the utmost care. About 20 per cent of the radium is lost but the remaining 80 per cent is finally delivered in little glass tubes in the form of a radium salt—such as radium bromide, radium sulfate, radium carbonate, or radium chloride.

Radium in its irreducible form is a metal, but as such it lacks stability and is therefore produced commercially as a salt. Indeed, the pure metal has been produced only once or twice and very few persons have ever seen it. It is described as a whitish metal having the appearance of the rare metals calcium or potassium.

In the reduction process considerable quantities of vanadium and uranium are recovered, and were it not for this fact radium would cost considerably more than $120,000 a gram—its present price. A famous expert on radium is authority for the statement that the law of supply and demand has very little to do with the price of radium. The selling price is set by the cost of extraction and the price can only be reduced as improved methods are found. Refinements in the process are constantly being made, but there is no immediate hope of any great reduction in price. Practical scientists place the thought that perhaps some revolutionary discovery will be made to eliminate much of the cost, in the same category with perpetual motion.

Radium emits three distinct rays. The alpha, which has been identified as positive static electricity and which forms about 90 per cent of the total emanations; beta, which is negative static electricity, forming about 9 per cent of the emanations, and gamma, which is a real ray—a vibration—and which forms the remaining 1 per cent of the emanations. In spite of the fact that the alpha rays compose most of the emanations, they have very little penetrating power; indeed, a sheet of paper will stop them. The beta rays are more powerful but can be stopped by about 1 centimeter of lead, while the gamma rays penetrate three or four centimeters of lead measuring over an inch thick before they are absorbed.

In the treatment of cancer and in the removal of useless tissue, for which radium has been found chiefly valuable in medical science, only the gamma ray is used. Sheets of metal are placed between the patient and the radium to shield him from the alpha and beta rays, which are likely to cause dangerous and painful burns. Thus the surgeon makes use of only about 1 per cent of the tremendous energy given off by the radium. When used in luminous material, however, the energy of the radium is 100 per cent useful.

Although the medical uses for radium were first to be discovered and investigated and the state of that art is, of course, much further advanced than the application of radium to luminous material, it would be difficult to say which of these uses is most valuable to mankind.

Does radium accomplish more good for a woman, for instance, if it saves her life by the elimination of a cancerous growth, or if the unfailing light of a radium indicator simply saves her at night from taking a bottle of poison from a shelf by mistake? Who can say but that thousands of lives were saved during the war because the mariner could steer his ship in utter darkness through submarine-infested seas with the aid of instruments illuminated by radium? How many air pilots have already been saved from death because the steady glow of radium-lighted instruments were the one thing on the 'ship' that never went wrong? And who can estimate the value to the airmen of the future? What of the miner, hundreds of feet beneath the surface of the earth, who is warned away from deserted passages and dangerous spots by radium-lighted signs that neither go out nor create an additional fire menace?

In a word, the only real concern we need to have about our supply of radium, either for medicinal uses or in industry, is a future source of ore. In this connection it may be recalled that in the early days of the oil industry it was thought that practically all the oil in this country was in the state of Pennsylvania. Just as oil was discovered over wider and wider areas as the demand for it grew, so radium-bearing ores have been found to supply the demand for the product. It is very reasonable to suppose that there are in addition to the present ample supply, many other radium-ores of which we know nothing, scattered throughout the world, and which will insure an ample supply for many years to come.

The Battleship and the Junk Heap

(Continued from page 312)

short distance from the water, if too high the tail of the torpedo, carrying the delicate Obry gear, will be smashed and the torpedo will not run true; (2) the plane must be pointed in the right direction to hit the target; (3) the plane must be at a certain definite angle to the water or the torpedo will go to the bottom; (4) the fighting planes from the fleet will be attacking the torpedo planes, and (5) *most important of all*, the secondary batteries of the fleet and improved destroyer anti-aircraft guns will be firing at the attacking airplanes all the time during which they are attempting to fulfil the exacting conditions noted above.

It may well be that progress in aircraft and submarine design will keep an enemy battle fleet further from one's own coast but, after all, in any except a European war, the sea power—which I hold to be the guns of the fleet—must be sent to the vital strategic area in order to bring its influence to bear in ending the war.

Now if the Briton is to control from the air, he must be able to send his airplane torpedoes to the vital sea area. In the present stage of development he must send them in ships, and all an enemy sea power needs to do is to find some means to destroy the airplane-carrying ships. That should be easy.

In the rapid development of all kinds of weapons of war the world has done wonders in the past half century. In this development every nation has been forced to meet type with type. If England is to be considered America's most probable enemy (which God forbid), if she goes heavily into construction of airplane carriers and relies solely on war in the air, then we must meet her, not only by some weapon to destroy her airplane carriers, but by war in the air. If some other nation holds fast to the battleship we must meet her by power on the surface. Again, if any nation, whose policies clash with ours, lays great stress on the submarine, Uncle Sam must be fully prepared to combat the submarine. This has been proved in the past when the torpedo-boat brought forth the design of the destroyer, and the armored cruiser was met by the faster, heavier gunned battle-cruiser.

One of the questions that form the main theme of the writing of the capital ship's principal enemy—Sir Percy Scott—is "What can the battleship do?" The answer comes from one of the underlying principles of sea power. The big gun ship places gun power, the controlling factor of naval strength, in the sea areas where needed. Big-gun superiority forms a point of support for cruisers and other warships and enables them to patrol and control the area in question.

Why Not the Pit Silo?

(Continued from page 313)

and second coats. This accomplished, digging may be resumed, the job being finished in sections until the requisite depth is attained—a method of performance eliminating the danger of the caving in of the silo.

As finishing touches to the subterranean container, a wall four feet high is built on the concrete curb, a variety of material being suitable, including concrete, lumber, concrete blocks, hollow tile blocks, or brick. The wall, occasionally constructed of woven-wire fencing, is a barrier to persons or live stock stumbling into the pit. A board roof covering is advisable. Space of two feet or more at the top of the wall for the free circulation of the air minimizes the possibilities of the accumulation of poisonous gases. A lighted lantern, lowered into the pit is used as a detector of gases—the lantern continuing to burn being a token of safety.

Hoisting equipment is a very necessary accessory to pit silos, a device for lifting the ensilage from its resting place and in some instances transporting the succulent material to the feed troughs. Although a major portion of these outfits are home-made, one of the photographs reproduced describes a patented hoisting device in use in the Panhandle area of Texas. The feeder can lift himself and the silage from the pit by an endless rope or chain which is operated over a large wheel near the top of the hoisting outfit. The carrier holding the silage is conveyed to the hooks on the trolley and thence transported to the feed trough. A framework similar to this one invites the installation of a horsepower hoist or a hand windlass.

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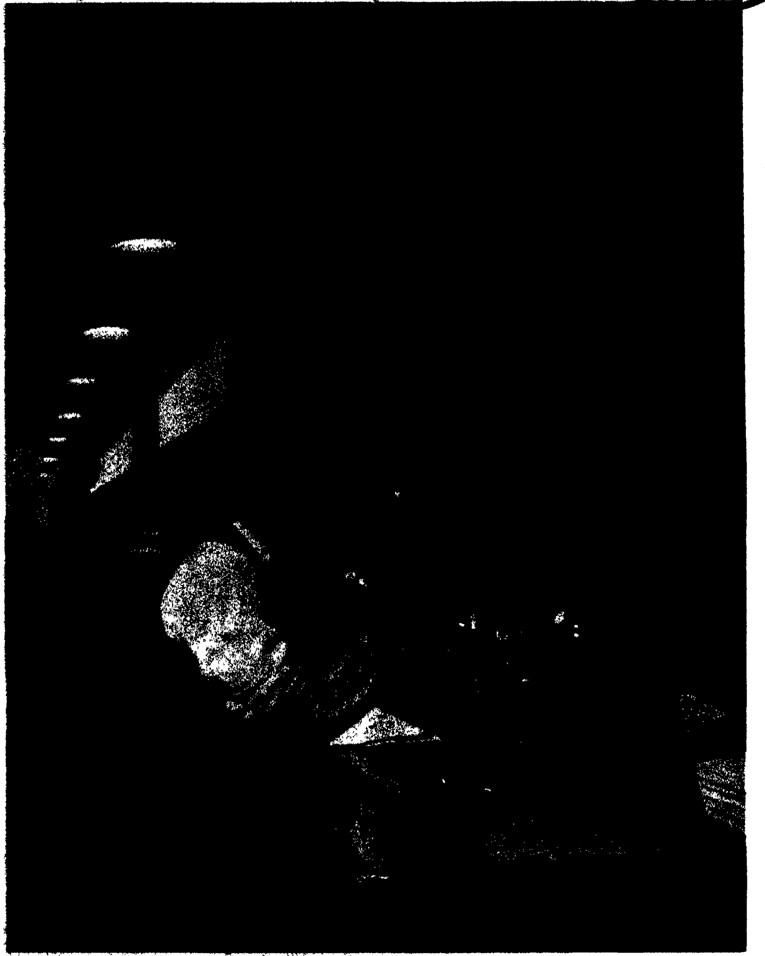
THE SAILING SHIP'S RETURN
MILK WITHOUT COWS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in
INDUSTRY · SCIENCE · INVENTION · MECHANICS

1 JUN 1921

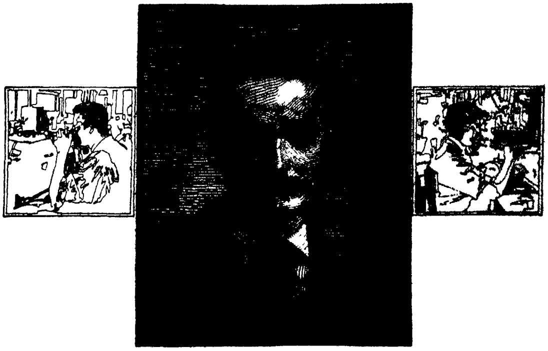


DIRECTING THE TRAIN OPERATION[illegible] RAILROAD TERMINAL.—[See page 329]

Vol. CXXIV. No. 17
April 23, 1921

Price 15 Cents
20 cents in Canada

THE SCIENTIFICALLY BUILT WATCH



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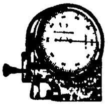
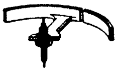
OF WALTHAM
The world's most famous inventor of watch-making machinery

ACCURACY

The Bearing of a Shaft that Measures only Six One-Thousandths of a Centimeter, the Diameter of a Normal Human Hair



Jaw Gauge



The Pivot or Shaft

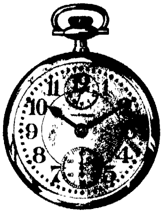
WE told you in a previous advertisement that the twelfth part of a human hair was the difference between the Waltham standardized accuracy and the variable guess work in foreign watches.

A normal human hair measures six one-thousandths of a centimeter. Imagine, then, the pivots or bearings of the Balance Shaft being only the size of a human hair.

If you should split one of the hairs of your head into six equal parts, each part would measure approximately one-thousandth of a centimeter. Yet, even this minute variation is eliminated by the Waltham standard of measurement. For instance, here is a Waltham Watch, the works of which are designed to perform on a pivot measurement of six one-thousandths of a centimeter.

But suppose this pivot was enlarged the third part of a human hair, friction would be increased, causing a variation in the time-keeping qualities of the watch.

The Waltham Watch Company has created marvelous gauges that measure even the twelfth part of a human hair to determine these variations and eliminate errors unseen by the human eye in the works of a watch, which mean all the difference to you in dependability and value, giving another of those unanswerable reasons why your watch selection should be a Waltham.



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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIV.
NUMBER 17

NEW YORK, APRIL 23, 1921

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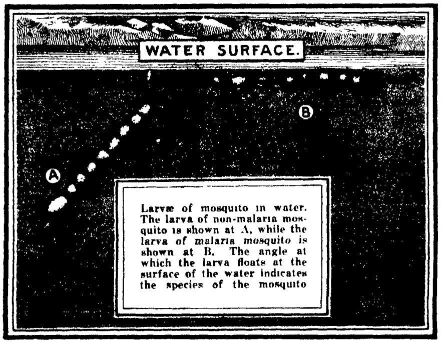
Man-Killing Insects

By George Philip Paul, M.D., C.P.H.

THREE-FOURTHS of all animal life consists of insects. Insects postponed the construction of the Panama Canal for many years. The tsetse fly of Equatorial Africa kills more people annually than do the African man-eating lions. The body louse or the world famed "cootie" was the cause of more deaths among the Serbian people during the Great War than were bullets. The "tiger" mosquito of Central and South America brings about a heavier annual mortality than do the many revolutions for which those parts of the world are noted. The common house fly yearly blots out the lives of thousands of innocent babes and young folks. The Anopheline mosquito of our southern states is accountable for a great many deaths and more cases of invalidism. The rat fleas have slain their millions by the dissemination of bubonic plague. And so, many other startling data might be rehearsed. But while a spectacular epidemic of influenza which kills its thousands will arouse the whole world, the death-dealing insects which are yearly responsible for hundreds of thousands of lives are relatively given but scant attention.



Larvæ of mosquito in water. The larva of non-malaria mosquito is shown at A, while the larva of malaria mosquito is shown at B. The angle at which the larva floats at the surface of the water indicates the species of the mosquito

Yellow fever, which is solely carried by a type of mosquito known as the "tiger" mosquito from its peculiar markings, or more properly as the *Aedes calopus*, is a disease of American origin. Not only is it carried exclusively by this type of mosquito, but solely by the female of the species. The mosquito must have bitten the person ill with yellow fever during the first three days of the disease and then a developmental period, within the insect, of the organism is necessary before the infected mosquito may give the disease to others. After a person is bitten by an infected mosquito the symptoms do not appear until two to six days elapse.

Yellow fever was one of the diseases that delayed the construction of the Panama Canal. Surgeon-General Gorgas cleared the canal zone of mosquitoes and yellow fever and made the rapid completion of the canal possible. Later General Gorgas rid Havana of this menace and at the time of his death was engaged in the eradication of yellow fever. While the disease is native only on the Caribbean Sea littoral and the West African coast, where endemic homes of yellow fever are located, the tiger mosquito has been found in the East Indies, in the Philippine Islands, China, Japan, southern Europe, Africa and Australia. The infected mosquito brought to these parts by a vessel may therefore become the spark to start a yellow fever conflagration.

A Dead Rat!

This cry in an Oriental city may herald a great outbreak of the plague. Plague is a rat disease transmitted to man by the rat flea. Before the occurrence of a plague epidemic in a city, there may be an extensive epizootic of plague among the rodents, especially the rat. These animals will die in great numbers. One can understand why the finding of dead rats in an eastern city may almost create a panic. The flea will not as a rule leave the rat until after the rodent's death. The flea derives its infective material or plague germs from the blood of its host the rat. The germs collect in the stomach of the insect where they multiply so rapidly as to prevent the flea from swallowing its food. To relieve itself the flea ejects the mass of germs through its mouth and may thus infect the rat or person upon whom it is living.

Fleas are wingless insects and move about by series of jumps. The eggs do not remain on the body of the rat but fall to the floor and there are hatched. The young forms of the insect exist on the accumulation of dust and filth that collects on the floor and continue their development to the adult form, which soon takes up its abode on the rat. Plague is said to be endemic in the ground squirrels of California.

Those who have read Atkinson's "Old Saint Paul" will have gleaned some idea of what an epidemic of plague means to a city. In 1665 London was visited by a very extensive outbreak. Authorities state that nearly one-seventh of the population perished during this epidemic. Three hundred years previously the great pandemic of "black death" overran Asia, northern Africa, and Europe and collected as its toll the lives of twenty five per cent of the inhabitant of Europe besides tens of thousands in Africa and Asia. Plague has invaded New Orleans and California. The last great outbreak of this disease occurred in Manchuria in 1910.

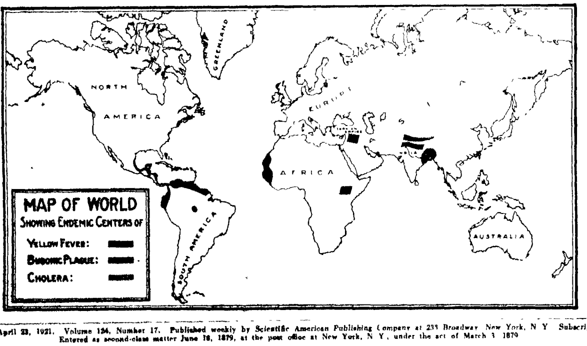
There are four endemic centers of plague—that is localities where the disease is always present and from which seed may be derived for an extensive outbreak in other parts of the world. One of these endemic centers is in Mesopotamia, two are in the regions of the Himalayas and the fourth is located in Uganda, Africa. The fight against plague is necessarily a fight against rats and their tenants the fleas. A systematic campaign is carried out in plague infected cities with the object of eradicating the rat population that may be suffering from the plague. The rodents are trapped, shot, poisoned, drowned and hunted with dogs. Their feeding places are destroyed. Buildings are made rat proof. In fact everything is done to bring about rat eradication. Ocean vessels harbor myriads of rats and may thus carry plague from port to port. To prevent rats from leaving a vessel the hawsers are provided with metal disc shields and the gangways are vigilantly guarded during the day and raised at night. Fumigation of the interior of the vessel at regular intervals will keep its rat population at the minimum.

The Body Louse and Typhus Fever

Soon after the commencement of the Great War the Serbian army captured great numbers of Austrian prisoners and with them Serbia received the seeds of a vast epidemic of typhus fever. The disease spread like wild fire and soon the little country was a seething mass of sickness. Her heroic doctors died in the midst of their efforts, the stricken Serbs lay ill in the highways and byways, hospitals and improvised hospitals were filled to overflowing. The Austrians with the aid of the body louse had brought Serbia more quickly to the verge of defeat than they could have hoped to do with all of the heavy artillery that they possessed.

In parts of Mexico this disease is constantly found. At one time Ireland was sorely tried by it, in the early eighties New York and Philadelphia experienced epidemics. The disease is transmitted from person to person by the common every day body louse or "cootie." During the late war very many of our soldiers engaged in active warfare were infested by the body louse. *Pediculus vestimenti* is the fancy name of this little pest. He principally takes up his residence in the underclothing and makes

(*Continued on page 335*)



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The Hudson River Bridge

INSCRIBED over the portals of an early and famous suspension bridge in Europe one may read the inscription, *Via Suspensa Difficile Est*, of which a very free translation would be, "It is no small task to swing a highway through the heavens" Doubtless the aborigines thought so when they first spanned a stream with their elementary suspension bridges built of the tough tendrils of trees and followed these with more ambitious structures built of cables woven of twisted fibers

The comparatively small strength of such materials set a stern limit upon the length to which these early bridges could be built, and there was a long wait through the centuries until the dawn of the iron age presented the bridge builder with a material which enabled him to construct more daringly And so it came about that in 1820 the famous engineer, Telford, by forging his iron into long, flat eye-bars, was able to build the famous chain-cable suspension bridge 1,000 feet in length which carried the post road to Holyhead across the Menai Straits by means of two shore spans, and a main span across the channel which is 590 feet in length

But the iron chain cable grew so greatly in weight as its length was increased that we had to wait until drawn wire presented the engineer with a material that was so strong in proportion to its weight as to open up greater possibilities in the building of long span suspension bridges, and that distinguished engineer Colonel Roebling, availing himself of the new material, did not hesitate to connect Manhattan and Brooklyn by a bridge whose main span measures 1,595 feet between its supporting towers

Further developments in metallurgy and the art of steel manufacture, particularly in the direction of alloyed steels, has so greatly extended the possibilities of long-span construction that today, in the bridge designed by Lindenthal to span the Hudson River, we have a structure whose main span is double that of the Brooklyn Bridge its floor space five times and its live load capacity fifteen times as great

If that engineer of an earlier day could come back, seven years hence, and look upon the completed Hudson River Bridge, he would feel, surely, that his Latin inscription could be placed above the portals with a stronger emphasis and a more profound significance than he himself had ever dreamed of And yet, to do him justice, it should be written here that progress in the science and technique of engineering has made such strides that the task of swinging this broad highway through the heavens great though it be, is no more difficult to the engineer of the twentieth century than was the feat performed by the bridge builder of one hundred years ago

Return of the Clipper Ship

ARE we on the eve of another clipper ship era? Is the stubby tramp steamer, lumbering from port to port at nine knots an hour or less to give place to the shapely fore-and-aft schooner, capable of doing her fourteen knots in a breeze and maintaining (thanks to her auxiliary motor) an average of ten to eleven knots for the whole voyage?

An answer to this question is suggested in the article on page 326 of this issue in which it is shown that the survival of the steam or oil-driven ship is a question of the cost of operation, particularly with reference to fuel cost In this connection we draw attention to the last report of the Chamber of Shipping of the United Kingdom which says: "Under present conditions very little shipping is being run at a profit, on a great many recent voyages heavy losses have been incurred"

It was similar causes, though they were not nearly so severe, which led to that marvelous outburst of sailing ship activity which has come to be known as the Clipper Ship Era, and unless there should be a very great reduction in fuel and labor costs (of which there is no evidence today) the sailing ship, except for fast freight and passenger service, must once more come into its own Should this happen there need be no anxiety on the score of speed, for the square-rigged clipper ships of the fifties were fast—very fast—and since their day there has been developed an American type that is faster yet—the big fore-and-aft schooner

The clipper ship in a breeze was able to show her heels to the steamers of her day and her average speed was superior Consider the "Flying Cloud" which in 1851 sailed from New York to San Francisco in 89 days, during which voyage she covered a continuous stretch of 5,912 miles at 9½ knots and another of 1,256 miles at 13¼ knots Later "The Lightening," in a gale, sailed 436 miles in a day, her speed rising at times to 18 and 18½ miles by log These were not large ships, their lengths being respectively 225 and 244 feet

Today we could do much better We have steel in place of wood for hull and masts, wire rope for all standing and running gear, to say nothing of the refinements in hull, sails and rig which the yacht designers with their long experience could work into the design

Furthermore, the square-rigger could not lie closer to the wind than 6 points She sailed 100 miles in going 38 miles to windward, and in calms she lay dead Our modern steel fore-and-after would lie up within 4 points and she would make 70 miles on her course for every 100 miles through the water, while in calms she would be good for 8 knots Finally, she would be from 300 to 400 feet in length, and other things being equal, means speed

Can Airplanes Destroy Battleships?

THE vigorous testimony before the Senate Naval Committee of Brig.-General Mitchell, of the Army Air Service, backed up as it was by the equally confident testimony of Rear Admiral Fullam, exploded in the ordinarily sedate atmosphere of that deliberative body with something of the shock of one of the General's own bombs Both these gentlemen represent that advanced school of thought which refuses to believe that the thing which has been must always continue to be, and they gave concrete expression to their convictions by telling the Committee that so rapid has been the advancement of aviation that within a few years' time the capital ship will be bombed off the surface of the sea

One outcome of the discussion was the determination to put the matter to the test by providing a battleship as a target and giving the Army and Navy Joint Board free rein to carry out an experiment on a full-size scale Preparations for the bombing of the ship on the part of the Army Air Service are being carried on at Langley Field, Virginia where some sixty officers, chiefly students of the Field Officers' School, are engaged in bombing exercises, using the new Glenn Martin bombing airplane, which has recently been delivered to the Air Service

Although the bombing of the battleship is to be carried out in all seriousness, it will not be possible to reproduce the conditions of actual battle; first, for the reason that in an engagement the modern battleship will be moving at a speed of something over 20 knots and on a zigzag course, and secondly, because the anti-aircraft guns of the ship will be played upon the bombing machines as they pass over The airmen, it is true, profess to have supreme contempt for the efficiency of aircraft fire, and in the testimony before the Senate Naval Committee they pointed to the fact as did some of the admirals who gave testimony, that the record of hits of airplanes in the Great War was only one hit per thousand shots fired Also, if the battleship that is used in these tests should be under way at the time of the bombing, and be steered by wireless on a zigzag course, the airmen claim that this movement will be actually favorable to hitting, because the planes will fly with the ship and their relative speed in passing over her will be reduced.

As a matter of fact, the crucial question is that of the elevation at which the bombs are let go. If the plane flies high, the chances of a hit are proportionately reduced. If she flies low, the velocity acquired by the bomb is proportionately reduced. It has always seemed to us that to cripple a battleship sufficiently to throw her out of line, it is absolutely necessary that the bombs penetrate the protective deck before they detonate The dilemma may be stated thus: Flying high means no hits, flying low means no penetration.

Now, if penetration of the protective deck is necessary, we run up against the difficulty that the greater part of the weight of the bomb must be given to the metal of which it is composed In other words, the bomb must take on the characteristics of the shell from a high velocity gun Its walls must be made thick enough to hold together until penetration has been effected This would mean such a great reduction of the TNT content that the huge airplane bomb would be robbed of much of its power Again, it must not be forgotten that before reaching and penetrating the protective deck, the bomb would have to pass through two and possibly three steel decks of considerable thickness, and, so far as we are aware, there is no delay action fuse existing which is sufficiently insensitive to stand this succession of shocks without letting go

All of which seems to show that one of the first things the advocates of battleship destruction by bombing must develop in what we might call a super-delay action fuse

Patents Secured by Officers of the Government

"AN officer of the United States Government does not dedicate his invention to the public when he secures a patent without payment of Government fees"

This is the opinion of the Attorney General of the United States in answer to a written request of the Secretary of War, dated November 24, 1919 The Act under consideration reads as follows

"The Secretary of the Interior and the Commissioner of Patents are authorized to grant any officer of the Government, except officers and employees of the Patent Office, a patent for any invention of the classes mentioned in Section forty-eight hundred and eighty-six of the Revised Statutes, when such invention is used or to be used in the public service, without the payment of any fee, *provided*, that the applicant in his application shall state that the invention described therein, if patented, may be used by the Government or any of its officers or employees in the prosecution of work for the Government, *or by any other person in the United States, without the payment to him of any royalty thereon, which stipulation shall be included in the patent*"

The Act, therefore, expressly states that the invention may be used "by any other person in the United States"

In the opinion given by the Attorney General, he carefully reviews the statutes having a bearing upon the subject and states that, so far as he knows, there has been no decision of the courts upon the question He is clearly of the opinion, however, that the Act was intended to encourage officers of the Government to patent their inventions and grant unto the Government the free use thereof, but that the Act did not intend that any one in the United States should have the right to make and use the invention for his own benefit or for the benefit of others

It would, therefore, appear that it is a dangerous matter for any one apart from the Government itself or a person, firm, or corporation, who is making or using the invention for the benefit of the Government, to attempt to manufacture and sell a patented article, even though such patent be granted to an officer of the Government under the provisions of this Act.

The opinion of the Attorney General appears to be a logical one, that an officer of the Government is entitled to such benefit as his patent grant may give him, in so far as such benefits accrue from the manufacture, sale and use of the invention by parties not connected with the Government and intended for private benefit.

It is, therefore, clear that the common and well-accepted idea that a patent granted to an officer of the Government without payment of Government fees is public property free to be used by any one, is a wrong interpretation of this Act.

Automobile

City Bus Lines Opposed.—Opposition was recently forthcoming by the Merchants' Association of New York to the establishment of organized motor omnibus lines in competition with existing means of transportation. The association insists that the competition would result in impairing present traffic without at the same time providing an adequate means of handling the traffic. Among the reasons given for opposing the introduction of any more motor omnibus lines in New York were the following: (1) Increased congestion; (2) increased cost to the city for street crossing protection; (3) increase in danger and in accidents as shown by England's statistics for London; and (4) that no emergency exists which calls for the establishment of motor omnibus traffic, other than the Fifth Avenue lines

Trucks Assist in Moving Steel.—Reports from Youngstown, Ohio, show that motor truck movements continue to play an important part in the reduction of the piled tonnage of the steel mills of the Mahoning Valley. Accumulation of unshipped finished and semifinished iron and steel products of the Mahoning and Shenago valleys several weeks ago amounted to 7,500 cars as against 7,900 cars the week before and 8,500 cars four weeks ago. In addition to movement of the curtailed current production, the warehoused tonnage was also being moved during the last four weeks at a most encouraging rate, although most of this reduction in the unshipped tonnage was largely due to improved rail conditions Trucking of steel to fairly distant points for rail shipments, and direct to nearby and distant consuming points is being vigorously pushed The use of motor transportation has ceased to be a wonder in the steel industry and excites little comment in this valley now It has however demonstrated that the motor truck generally used in this territory was not especially designed for steel shipments and it is expected that the truck builders who take advantage of this and send their engineers and designers into the territory can develop trucks that will meet the need

Many Kinds of Knocks.—One of the most irritating things to a motorist is a knock somewhere in the car Some knocks are so baffling to locate and remedy as to give unceasing trouble even to the experts of the garage and service station. But with care the owner may find and eliminate the ordinary causes Perhaps the most frequent kind is that which comes from carbon deposits With low grade fuel, such as the motorist is compelled to buy at the present time, there is every chance for carbon to accumulate in the combustion chambers and on the piston tops Faulty carburetion, poor lubricant and poor compression due to worn piston rings facilitate its production, and many engines, even in high-grade cars, have a tendency to accumulate carbon This is especially noted if the oiling system operates at considerable pressure Most high-powered engines are constructed for as high compression as possible, in fact, this is carried almost to the point of pre-ignition Then, when a film of carbon forms in the combustion chamber, it raises the compression so there is pre-ignition and consequently a knock One should not jump to the conclusion, however, that every knock is caused by carbon deposits in the engine Not all knocks are damaging to the engine, but some of their causes, such as a loose connecting rod bearing, a loose cylinder, or a broken moving part, might prove immediately injurious

Notes on Skidding.—There are two main facts regarding skidding that are apparent to anyone who drives a car One is that a car skidding sidewise on the rear wheels slides over the smooth surface to a point where the surface is rougher and the tires begin to take hold The skid, however, does not stop immediately at the first rough spot, but due to momentum and the weight of the car, grinds the rubber over the rough spot a certain distance which has the effect of a rasp being used on the tires This is particularly the case when the wheels are locked It is a well-known engineering fact that railway cars with steel wheels running even on a glassy surfaced rail will, if the wheels be suddenly braked while the train is in motion, flatten a spot on the steel rim in a short time, so much so that the succeeding pounding of this flat spot will eventually split the rim It is easy to imagine the effect on a rubber tire under the same action on a road surface when the car is braked suddenly when traveling in a forward direction. The wheels lock instantly, but the momentum and weight of the car drag the hot rubber along on the flat spots on the rear wheels. The placing of the hand on these spots immediately after will convince one that this does not need to occur very often materially to injure the tire With chain equipment and common sense driving, the car need not even start to skid and thus grinding of the tires is unnecessary.

Science

Beer Vat Mushrooms.—The raising of mushrooms in one-time beer vats is coming into considerable prominence. Probably no other industry is more profitable that could be carried on in an ante Eighteenth Amendment brewery. This "infant industry" is already asking for tariff protection

Sailing of Cope Expedition.—Commander John Cope of the British Imperial Expedition, which hopes to reach the South Pole by airplane, has sailed from the Falkland Islands. The western shores of Weddell Sea will be surveyed and charted and other scientific investigations will be carried on

Big Game Protection.—Work of marketing the boundary of Mount McKinley National Park as the first step in establishing protection over the region which is described as the fountain head of the big game herds of Alaska will begin as soon as the weather permits, the National Park Service announces

Skin Disease of Cathedral Windows.—York Minster, one of the most beautiful cathedrals of England, famous for its glorious stained glass is in trouble Some mysterious disease has attacked the stained glass It takes the form of minute holes which in time deepen and cause the glass to flake Some portions are as thin as tissue paper and crumble at the touch No one knows a cure

Oil Fumes Put a Town to Sleep.—A curious result of a railroad accident in which 8,000 gallons of naphtha were spilled, is reported from Roelots, Pa The oil ran into a pit and the odor was so penetrating that cattle died and one man succumbed As time went on the inhabitants of the town were attacked by a sleeping sickness and everyone began to drowse A number of the residents moved out of town until the naphtha had dried up

A Wild Life Refuge.—The Rockefeller Foundation has presented to the State of Louisiana a tract of country comprising some 35,000 acres known as the Grand Chenier Wild Life Refuge The land was purchased by the Foundation from individual holders in 1914 in order to preserve the wild life of the country, and it is a condition of the gift, which includes laboratories, publications and equipment connected with the preservation enterprise, that the tract shall remain as a perpetual wild-life preserve

A Mean Thief.—Platinum was not always as precious as it is today, and formerly it was extensively used to tip lightning conductors. Italy has been having an epidemic of church steeple climbers who filch the rare metal from the conductor tips, but Paris with its much-vaunted police system ought to have been immune Some enterprising burglars scaled the tops of both towers of Notre Dame and stripped the top of each conductor of about six ounces of platinum No trace of the thieves has been found, but the police think they were ex-steeple jacks gone wrong

Fruits from South Africa.—Fruits from South Africa are the latest novelty in the New York City food markets Not only do the African fruits appeal to the palate of those who long for peaches, plums and melons of summer time, but they are a delight to the eye. Strange crosses of peaches and plums and apples have resulted in colors of deep red splashed with yellow in odd shapes that are unfamiliar to most of us The fruits are all carefully selected and packed in excelsior They come under refrigeration, mostly by way of England, the trip taking a minimum of four weeks

A Scientific Drug Expedition.—An expedition led by Dr Rusby of Columbia will visit the unexplored areas of Venezuela, Bolivia, Ecuador and eastern Colombia The enterprise which is strictly scientific, is being financed by a Philadelphia chemical company and will consume eighteen months The explorers will attempt to study and bring back for further examination here specimens of birds, insects, flora, reptiles, fish and other creatures that abound in those regions They also will seek new light on tropical diseases, their origin and their cure. The results of the expedition will be given to the world

Difficulties of the Heidelberg Observatory.—The annual report of the famous observatory on the Königstuhl, near Heidelberg, for the year 1919, paints a gloomy picture of the affairs of that institution Suspension of service on the tramway leading to the observatory has imposed great hardships on the staff besides making it impossible to secure labor for making needed repairs Lack of heat has led to much damage by dampness Photographic work was reduced to a minimum on account of the expense of plates Nevertheless considerable work was carried on, and the achievements of the year included the discovery of 28 new asteroids

Aeronautics

A British Giant.—It is understood that the British are trying their hand again at giant aircraft, this time a flying boat which will be called the "Titania," and which will be fitted with four Rolls-Royce "Condor" engines as originally intended, developing a total of 2,400 horsepower

Japan's Air Routes.—Great interest is being displayed by the Japanese in the development of commercial aviation It is stated on good authority that the Japanese have placed substantial orders with the British for airplane engines and parts and for flying boats of British construction Manufacturers of airplanes and their accessories are going to Japan to open up business with the Japanese, whose ultimate object is to establish land and coastal routes for commercial purposes in various parts of the Eastern Empire

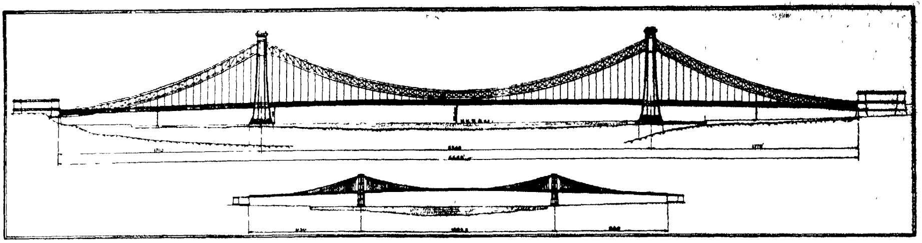
Airplane Service Between Amsterdam and Paris.—On April 14th last an airplane passenger service began between Paris, Brussels, and Amsterdam, which is to be extended at a later date to Copenhagen, and will also include Bremen and Hamburg Daily a machine leaves Paris at 11 A M, making landings at Brussels and Rotterdam, and arrives in Amsterdam at 3 30 P. M An airplane leaves Amsterdam daily at 9 A M, and arrives in Paris at 1 30 P M Thus the journey consumes only 4½ hours—one-third of the time now required by railway

British Airplane Factory in Japan.—A group of British airplane construction experts has arrived in Nagoya Japan, according to a recent report, under a three year contract with a Japanese company, in order to supervise the construction of airplanes in all details It is expected that a complete manufacturing plant will be organized, capable of turning out the most approved type for all purposes Though the entire building construction of the company will probably not be finished for two years, it is understood that the building of motors and assembling of planes will be started in certain units of the plant as they are completed

Germany's Aviation Industry.—When the war ended, according to *Aeronautics*, Germany had some 40 airplane factories at work, which were turning out about 2,500 machines a week After the defeat of Germany and the subsequent revolution, the majority of these firms switched over to other work Three firms decided to manufacture machines for civil aviation These were the Sablatnig Company of Berlin, the Junkers Company of Dessau, and the Fokker factory of Schwerin The Germany Government is watching these developments closely, though present conditions do not allow it to take any open part in furthering the building of airplanes The industry is encouraged to maintain its factories at a state of efficiency which will enable it to go ahead immediately when the time comes The skilled labor is being kept employed

Kite Balloons for Commercial Use.—Although there are undoubtedly important uses to which kite balloons can be put, some very impractical suggestions have recently been made by enthusiasts for this particular craft regarding its commercial use The value of the kite balloon in connection with meteorological observations is undisputed, and under certain conditions, as landmarks on air routes kite balloons may be of the greatest assistance, but the suggestion that they should be towed from trawlers to "spot" shoals of fish is not quite so acceptable, we are reminded by *Aeronautics* The small airship probably has greater possibilities in this direction than the towed captive balloon, but the present cost of an airship makes its use impracticable, nor is the speed of a small airship sufficient to insure more than occasional use Another suggestion which has been put forward is that firms should use kite balloons for displaying advertisements

The Caproni "Nineplandem", as the giant Caproni flying boat has been nicknamed from the fact that it has three triplane sets of wings arranged one behind the other, made its first flight on March 2nd, according to latest reports The machine is stated to have got off well and to have risen to a height of 20 feet This indicates that no attempt was made to fly the machine, the tests being merely to test the "planing" capacity to see if it were possible to "unstick." In addition to the pilots and mechanics the machine is stated to have carried about 1½ tons of ballast to represent some of the 100 passengers which the machine is designed to carry On March 4th, we learn through *Flight*, it was announced from Milan that the Caproni "Nineplandem" made a second test flight but that in descending something went wrong and the machine made a bad alighting on the water The pilot and mechanics were uninjured, but the machine is said to be pretty badly damaged



The towers of the Hudson River Bridge are of the same height as the Woolworth Tower. They will be built of steel and clothed entirely with smooth-dressed gray granite

Side elevation of the proposed Hudson River Bridge and of the Brooklyn Bridge drawn to the same scale

The Hudson River Bridge

A Great Highway for the Steam, Rapid-Transit, Motor-Truck, Automobile and Trolley Traffic That Crosses the Hudson

AT last, after many delays, the latest of which was due to the war, the preliminary work necessary for the construction of the Hudson River Bridge is well under way. A staff of engineers which includes some of the most distinguished men in the country has been formed, and back of the great work there is a group of leading financiers, railroad men and others who have a wide practical acquaintance with transit problems.

The traffic situation in New York and vicinity labors under many disadvantages, and by far the greatest of these is the existence of the broad stretch of the Hudson River, cutting off Manhattan Island, the heart of New York, from the mainland and its vast network of railroads. Once this obstacle has been removed, the traffic problem will be solved. That has always been well understood. The outstanding question has been how best to accomplish this, and it was with an undeniable touch of genius that Gustav Lindenthal conceived the problem of connecting Manhattan and New Jersey not by a series of separate structures, but by one vast bridge whose proportions would be such that it could easily take care of the whole of the traffic which surges to and fro between Manhattan Island and the mainland.

It was not idealism or any striving for the spectacular that led to the conception of this bridge upon such a gigantic scale. Rather, its dimensions have been determined by the severest application of the principles of economy. In all constructive engineering work, whether upon land or sea, it has been proved over and over again throughout the past decades that there is economy in concentration. We see it in the 900-foot steamer, the 400-ton locomotive, the 100-ton freight car, the multi-storied office building, and in the huge factories which are characteristic of American manufacturing industry. Similar economies both in the first cost and the cost of operation, will be achieved by solving the vast traffic and transportation problem between the Western continent and Manhattan Island, by the construction of a single bridge of unprecedented dimensions. Our illustrations are the first official drawings of the great structure to be made public. For purposes of comparison, an elevation and cross section of the Brooklyn Bridge are shown on the same scale; and anyone who has been impressed with the magnitude of the older bridge will quickly sense the stu-

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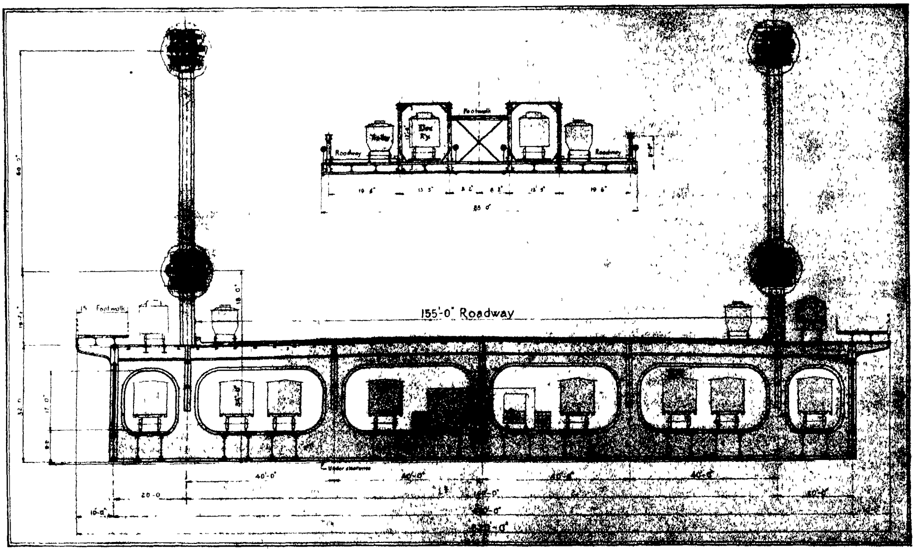

Each of the four cables will consist of three banks of steel eye-bars, enclosed in watertight bronze tubes, to protect them from the weather. Each pair will be braced together to form a deep stiffening truss. At every 60 feet will be suspended a massive plate-girder floorbeam 32 feet deep and 200 feet long. Framed in between these will be the longitudinal stringers of the two decks. The upper deck, 220 feet wide, provides for two passenger footways, two trolley and two rapid-transit tracks, and a boulevard for motor truck and automobile traffic of 155 feet clear width. This floor will be watertight and will completely cover in the lower deck, on which will be ten railroad tracks for main line freight and passenger trains

Cross-section of the Hudson River Bridge compared with that of the Brooklyn Bridge

Left: **Manufacturing and bottling room of the mechanical dairy.** ***Right:*** **Mixing vats and emulsors for making reconstructed milk**

Milk Without Cows

By S. R. Winters

A MECHANICAL dairy—affording an adequate milk supply to a city of 25,000 population in the absence of cows—is a commercial reality hitherto unheard of, a triumph emerging from war-created difficulties in Nitro, W. Va. It was the first commercial demonstration of the possibilities of producing fluid milk from a cowless dairy in the United States.

I hasten to explain the significance of the coined phrase, "mechanical dairy," lest the reader ponder the question originally asked by the SCIENTIFIC AMERICAN when the subject was submitted in a skeletonized form, "Just what do you mean by this term?" Technically described as reconstructed milk, the product is made by the emulsification of butterfat in normal skimmed milk. Reconstructed skimmed milk is obtainable either by diluting unsweetened condensed or evaporated skimmed milk with distilled water or by dissolving dried skimmed-milk powder in distilled water. Skimmed-milk powder was used in the Nitro manufacturing establishment as a source of solids not fat, and a first-rate quality of unsalted butter as a source of butterfat. The percentage of fat and solids not fat were proportioned in accordance with the different products being manufactured. Reconstructed milk, reconstructed cream, ice-cream, and fermented milk products, such as cultured buttermilk and cottage cheese were produced by the war-created mechanical dairy.

A liquid closely resembling milk and cream as the result of emulsifying butterfat obtained from unsalted butter in a solution of skimmed powder-milk or diluted evaporated skimmed milk had previously appeared on the market. The procedure is popular with the ice-cream industry, and Army field hospitals as well as battleships have produced limited quantities of the fluid. Then, too, the National Dairy Show has frequently exhibited this liquid as a method of advertising milk powders. Success in obtaining a satisfactory product on a small scale was responsible for the assumption that operations of magnitude could be undertaken with reasonable expectations of obtaining a liquid that would at least answer the emergency.

Dairy cattle were scatteringly distributed in this mountainous region of West Virginia, a cow to the family obtaining rather than in immense herds as are maintained in Wisconsin and the Middle West. Congestion of railway facilities rendered uncertain the delivery of a potential source from the dairying communities of Ohio. In a word, a city of 25,000 inhabitants was without any visible milk supply. The United States Public Health Service shouldered the responsibility of devising ways and means of coping with the unforseen contingency. The inviting environments amid which the undertaking was launched are obvious—absence of competition with the contents of the milk pail, assurance of a responsive market, and no violation of traditional health regulations. Yet it was with some trepidation that the procedure was authorized in view of the existing laws in the interest of health which prohibit the modification of natural food products. The known source and method of preparation—unmistakably indicated on the label—obviated any objection from this angle. Special bottle caps bearing the words, "Reconstructed Milk," or "Reconstructed Cream," revealed the identity of the product as well as the percentages of ingredients.

An equipment capable of handling 2,000 gallons of bottled milk in an eight-hour day, with the opportunity of increasing the output to 3,000 gallons a day by the addition of another pasteurizing and emulsifying unit, was agreed upon as adequate. Milk and cream could be dispensed in either bulk or bottled form, although ample equipment was available for bottling the output. The milk-handling machinery consisted of a buttermilk machine of 300 gallons capacity, a milk pump, two 300 gallon ice-cream batch mixers, two centrifugal emulsors of 200 gallons capacity each, belt-driven from 2-horsepower motors, one tubular milk cooler of 5,000 pounds per hour capacity, composed of two sections, one for water and one for brine, an antifoam tank, a rotary bottle filler and capper, scales and tanks for weighing water, and scales for weighing butter, a porcelain topped table for cutting butter, and a Babcock tester. All of the machinery, except the mixing and pasteurizing vats, emulsors, butter scales, and butter-cutting table, was located on the main floor. The latter machines were on the balcony. The headroom required to insure a gravity system from the mixing vats to the bottle filler was not determined before construction of the building was begun, which fact necessitated the elevation of the mixing vats two feet above the floor of the balcony. They were supported on a stand made of 2-inch pipe, which arrangement should be avoided as it retards the speed of the machinery.

The sundry machines were connected with 1½-inch milk piping, and the valves and fittings were of the sanitary type, easily cleaned. Overhead shafting was obviated, the various machines being operated by individual motors. As originally designed the engineers did not contemplate the manufacture of ice-cream but the demands for the product were met by the installation of two can freezers, which supplanted a 60-quart continuous brine freezer purchased but not put in operation. These were placed in the balcony, and motor driven. Bottles were washed with an automatic jet washer, cleaning 4,000 bottles an hour. The pumps of the machine were set in motion by a direct-connected 10-horsepower motor. The washer was located in the center of the room and was oriented so

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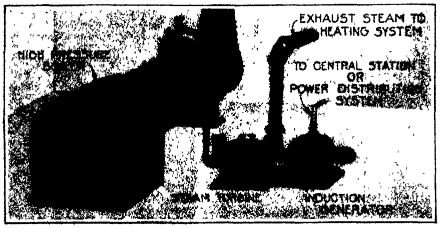

EXHAUST STEAM TO HEATING SYSTEM
HIGH PRESSURE BOILER
TO CENTRAL STATION OR POWER DISTRIBUTION SYSTEM
STEAM TURBINE
INDUCTION GENERATOR

Diagrammatic outline of the apparatus which Dr. Steinmetz suggests for the recovery of power that now goes to waste when we burn coal for heating purposes

Stopping Our Coal Leaks

By Charles P. Steinmetz

THE two sources of energy which are so plentiful as to come into consideration in supplying our modern industrial civilization are fuel (including coal, oil and natural gas) and water power.

In 1918, 867,000,000 tons of coal were consumed in the United States. As it is difficult to get a conception of such enormous amounts, I may be allowed to illustrate it. One of the wonders of the world is the Chinese Wall, running across the country for hundreds of miles by means of which China unsuccessfully tried to protect its northern frontier against invasion. Using the coal produced in one year as building material, we could with it build a wall like the Chinese Wall, all around the United States, following the Canadian and Mexican frontier, the Atlantic, Gulf and Pacific Coast, not only hundreds, but thousands of miles, and with the chemical energy contained in the next year's coal production we could lift this entire wall up into space, 200 miles high. Or, with the coal produced in one year used as building material, we could build 400 pyramids larger than the largest in Egypt.

We realize that our present method of using our coal resources is terribly inefficient. We know that in the conversion of the chemical energy of coal into mechanical or electrical energy, we have to pass through heat energy. This involves a transformation from the low grade heat energy to the high grade electrical energy. We get at best 10 to 20 per cent of the chemical energy of the coal as electrical energy, the remaining 80 to 90 per cent we throw away as heat, or, worse still, have to pay for getting rid of it in the condensing water. At the same time we burn many millions of tons of coal to produce heat energy, and by degrading the chemical energy into heat, waste the potential high grade energy which those millions of tons of coal could supply us.

It is an economic crime to burn coal for mere heating without first taking out as much high grade energy, mechanical or electrical, as is economically feasible.

Assume we use 200 million tons of coal per year for power at an average total efficiency of 12 per cent, giving us 24 million kilowatts, and that we use 200 million tons of coal for heating purposes, wasting its potential power.

If then we could utilize the waste heat of the coal used for power generation, even if thereby the average total efficiency were reduced to 10 per cent, we would require only 240 million tons of coal for producing the power, and we would have left a heating equivalent of 216 million tons of coal, or more than required for heating. That is, the coal consumption would be reduced from 400 million to 240 million of tons, a saving of 160 million tons of coal annually.

Or, if from the 200 million tons of coal, which we degrade by burning it for fuel, we could first abstract the available high grade power, assuming even only 5 per cent efficiency, this would give us 10 million tons, while the production of the 10 million kilowatts now requires 100 million tons of coal. Or putting it the other way, we should have a gain of 9 million kilowatts—12 million horsepower on 24-

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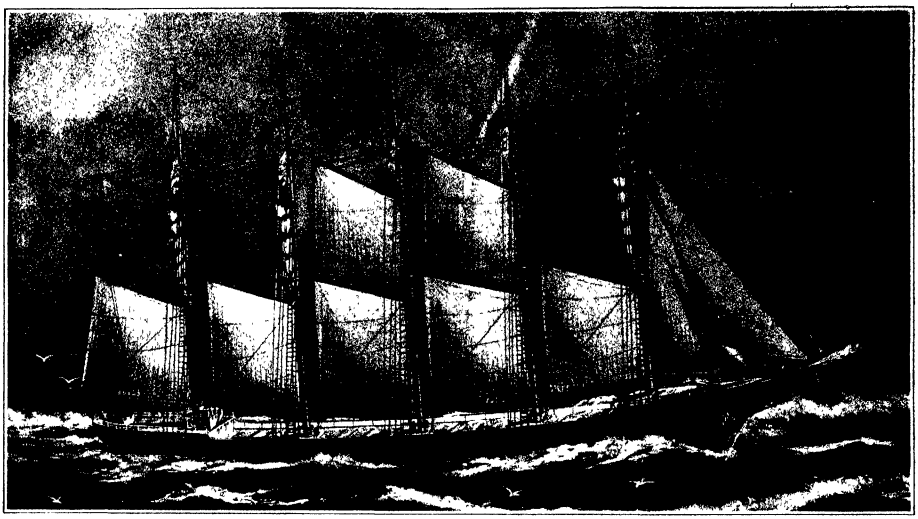

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The above design for a fore-and-aft schooner was presented at the last meeting of the Institution of Engineers and Shipbuilders in Scotland, as a solution of the present shipping situation in which it is found that because of high fuel and labor costs, only in rare cases can a steam or oil-driven ship be run at a profit. The design aims at reducing the size of the crew by the use of double gaff sails, and the use of steel wire rope for all running gear led to independent drum, motor-winches operated by switches from the quarter deck The vessel will be equipped with a single feathering propeller, driven by a Diesel engine, which would also supply light and power throughout the ship

Proposed type of steel auxiliary merchant ship with upper and lower gaff sails

The Sailing Ship's Return

Will the High Costs of Operation Bring In Another Sailing Ship Era?

By John T. Rowland

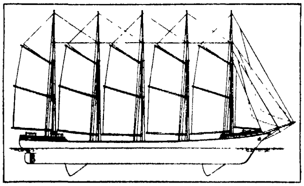
HAS the day of the "windjammer" come back to stay? Practical sailormen have been looking forward to it ever since the war, and now comes a voice from across the Atlantic which asserts positively that such is the case In a contribution to the *Transactions* of the Engineers and Shipbuilders of Scotland for February, 1921, C O Liljegren makes a most interesting case for the return of the sailing ship to its ancient predminence upon the Seven Seas

This forward-looking naval architect and yacht designer, who, by the way, served an apprenticeship on this side of the ocean under the great Herreshoff, bases his argument wholly upon the economic features of the situation In a merciless analysis of the fuel outlook he shows that the cost of operating a machine-driven ship will, in the *average case continue to equal* or surpass her earnings for an indefinite period to come

By the use of a most illuminating series of graphs, one of which we reproduce on this page, Mr Liljegren endeavors to make it clear that the steamship is not the permanent pillar of commerce that we had come to believe it, but on the contrary that it has owed its predominance to industrial conditions which now are past—never to return Its recent domination of the seas has been coextensive with the period of cheap fuel, just as the day of the pot hunter was coextensive with the period of abundant wild game

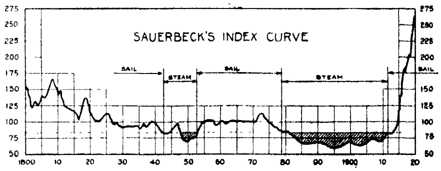
This will come as a startling idea to many persons Mechanically driven ships in late years have so completely captured the world's trade that few of us realized by how tenuous a thread their very existence depended how utterly they are at the mercy of fuel cost Yet the thing has been demonstrated before

Fig 1, *Sauerbeck's index*, represents the *means* price of 15 commodities, fuel being among the most important included, for the past one hundred and twenty years It shows that only when this mean price level was below the line of 82.5 of the index has steam been able to compete on favorable terms with sail in world trade



Outboard profile, showing full sailplan, the two centerboards, cruiser stern and feathering propeller

Sail reigned supreme up to 1842 although mechanically the steamship was sufficiently developed to give sail a hard run many years earlier High cost of fuel was the real limiting factor



This diagram shows that in the past 120 years, only when the mean price of commodities, including fuel, was below a certain level (82.5 in the diagram) has steam been able to compete on favorable terms with sail in world trade

During the period between 1842 and 1845 steam was able for the first time to "break even" with sail, then a peak of high fuel cost shut it out again From about 1848 to 1852 the pendulum swung for the first time positively to the side of steam but the advantage was again pinched out, except for fast freight and passenger service, when prices rose in the troubled period which ushered in wars and hard times on both sides of the Atlantic

It was only about 1879 that the mechanically-driven vessel came definitely to the fore as the most economical form of ocean carrier And the graph would indicate that this condition has ended now as abruptly as a lake ends at the foot of a beetling cliff The fact of the matter is that the mechanical vessel consumes great quantities of an increasingly valuable commodity—fuel No one would think today of attempting to fire a ship's furnaces on pitch pine: the cost alone would be prohibitive. Ten years from now coal and oil may be in the same class

Indeed, at the present time the fuel-consuming ship is not able to make a living, and there is little save blind optimism to point to an improvement When this condition has been in effect for some time one of two things must come to pass: either the world's commerce will cease to be, or a cheaper means of transportation will come into vogue—cheaper, that is, in respect to propulsion even if all other factors remain the same

"Wind is the one thing that has not changed in price," Mr. Liljegren cogently argues, "and, unlike fuel, does not cost more to give more speed." Why not, then, make use of this immense reservoir

(*Continued on page 338*)

Bowling On the Green

By William Henry

THE game of Bowling on the Green is a very ancient one, in fact its origin is known to go farther back into the mists of time than the Middle Ages. Shakespeare frequently mentions bowling as in "Love's Labor's Lost," "Taming of the Shrew," "King Richard 2nd," and "Merry Wives of Windsor." In Quarles' "Emblems 1635" is mentioned "The Devil's Bowling Green," a sermon in Bowls.

Bowling on the Green originally was played by using stones which described a curving line when rolled toward a point or jack which in those days was a cone. Some time later the bowls were cut from the inside of a tree, the side toward the heart being heavier caused the bowls to roll in a curve.

The bowls today are made of lignum vitae, a very hard wood, and the curve or bias is given to the bowl by having one side more convex than the other. They are usually 16½ inches in circumference and weigh 3½ pounds. One side has the player's initials engraved on it, while the other, which is the biased side, is numbered, and this side, when playing, is kept on the inside or next the player's body.

Among the early New Yorkers Bowling on the Green was a favorite sport. There was an old Bowling Green at the foot of Murray and Warren Streets on what was known as "King's Farm."

In 1782 Bowling Green at the foot of Broadway was leased at a yearly rental of a pepper-corn by John Chamber, Peter Bayard and Peter Jay, and at that time it was enclosed by a fence and laid out as a Bowling Green.

After the Revolution the game seems to have been ignored, but it was revived in 1879 by Mr. Christian Schefflin of Dunellen, New Jersey, who started the Dunellen Bowling Green Club. Following New Jersey's example, other clubs were started up until today we find Bowling Green Clubs in a great many cities, such as Brooklyn, Boston, Hartford, Pawtucket, Buffalo, etc., while along the northern New York border and Canada nearly every town has its Bowling Green.

A modern Bowling Green is laid out as a square 120 feet to a side. Two kinds of greens are used, the crown green which slopes each way from the center, and the level green which is the one most popular in this country.

The grass has to be kept cut close and rolled perfectly level, and the players use rubber-soled shoes without heels in order to protect the green. The game is played usually in one direction, and at right angles to that on alternate days. A sloping terrace, or bank, 2 feet high runs all around the green, and a ditch 6 inches deep and 18 inches wide runs inside the terrace.

The green is divided into rinks about 20 feet wide, and a marker is put in the terrace showing the center of each rink.

The game is usually played by two, three or four persons to a side, when single handed or pairs game, each person uses four bowls, but if three or four are on a side only two bowls are necessary to each person.

The jack is a white ball 2½ inches in diameter, which is thrown down the green by the first player, and centered in line with the marker in the bank at the place where it stops rolling. The bowls are rolled toward the jack by one player of each side alternately.

Preparing for a critical bowl

Each team is captained by a skip whose word is law and must be obeyed by the players. The skip is the last one to play, after the three preceding players of his team have sent in their shots guided by his signals. When the skip plays the third player on his side acts as skip. After all the shots are in the bowls are counted to see which side has one or more nearer the jack than the opposing team. This constitutes the finish of an 'end' and a game usually consists of 21 ends or less as arranged by the two skips.

Sometimes it is necessary in a close end to use a large pair of calipers in order to decide which bowl is nearest the jack.

Whichever team wins the end is entitled to throw the jack down the green and in this way the length of the rink played varies all during the game.

When the bowls curve on the right side it is called the forehand. When they curve to the left it is back hand. Any bowl which touches the jack is always alive, and is called a toucher.

Science plays a very important part in this game as it is possible to put a bowl in front of, or behind, or even to take away an enemy shot. When tested on a level green, the bowl describes a curve of not less than 3 feet at a distance of 32 yards.

The physical benefit derived from this game is considerable as it calls into exercise the keenest powers of vision, the sensitive touch of the hand, the most careful concentration of the mind, and the beautiful environment of the green with its velvet carpet. All these combined make an ideal sport for any business man.

Cinematography at the Winning-Post

By Dr. Alfred Gradenwitz

IT has long been known that the judge having only his visual impression to guide him is not always able to pronounce a reliable sentence at horse races, and the use of moving picture records has therefore been suggested. However, because of the high racing speeds (about 15 meters per second), the ordinary cinematograph is of no help in this connection, the average of 18 views per second being insufficient to insure a record of the horse at the very moment his nose is passing through the winning post. Nor can high speed cinematography be resorted to, the apparatus here being too heavy and complicated to be used for this purpose apart from the impossibility of appreciating the results and enlarging the decisive film sections at a moment's notice.

Following up a suggestion by Captain Stahlknecht, C. P. Goerz, of Berlin, designed an outfit by means of which snapshots with minimal exposures can be taken at right angles to the horses' path, just fixing the moment when the winning horse with the point of his nose is passing through the plane of the winning post. A special camera is placed exactly in the plane, which, after closing an electric circuit, automatically effects a number of successive views with exposures varying between 1/800 and 1/1200 second. One of these is certain to indicate with the utmost accuracy the relative position of the horses at the decisive moment of the race.

Whenever there is a close finish the judge will have a means, before giving out his verdict, of resorting to photography, by causing a plate bearing the inscription "Photography" to be lifted in the place of the number of the winning horse. Experience goes to show that the audience not only willingly submits to this slight delay, but insistently requests the use of photography.

While not being cinematography in the strict sense of the word since it uses plates instead of films, the new method is based on the fundamental principle of cinematography—the photographical fixing of a number of successive phases of movement, following one another at very high speeds.

In order to install on a race course an outfit for the Stahlknecht-Goerz method, the following preliminaries have to be carried out once for all:

(1) Mounting a camera bracket at the judge's stand or at some suitable tower, so that the objectives lie vertically above the winning post line.

(2) Providing an auxiliary finishing line 3 meters before the winning post by connecting a white aiming rod about 3.5 meters high with an aiming wire on the opposite side of the course, where the switch-lever is fixed.

(3) Providing a dark room with all installations required, as close as possible to the judge's stand.

The outfit is a system of five cameras placed above one another, the shutters of which are automatically disengaged in succession, by pressing the key of the switch. Before taking the apparatus into use the objectives should be adjusted to the distance required, depending on the width of the race course; the apparatus must, to this effect, as well as for the sake of ad-

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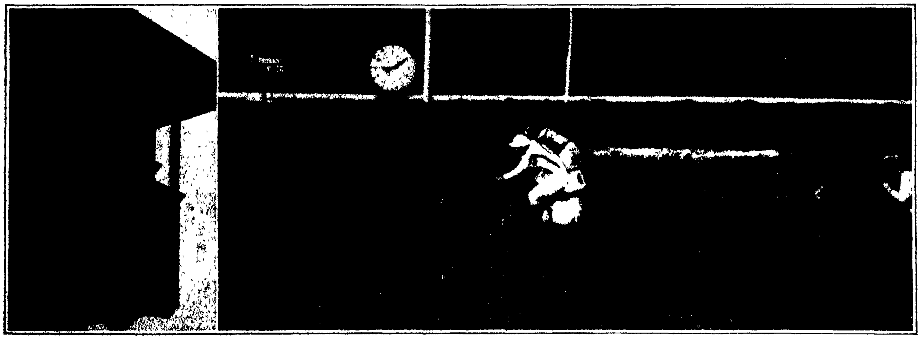
The five-fold camera used at the Berlin race track to aid the judges in deciding a close race, and a plate showing a triple dead heat which was run on July 1st, 1920

Succeeding in Scientific Farming

A Survey of the Opportunities Awaiting the Man Who Is Going Back to the Land

By Raymond Francis Yates

BECAUSE of the present slackening up in industrial activities throughout this land of ours, it is altogether natural that we should have a powerful revival of the back-to-the-land movement For it is a fact that this movement comes and goes just like the tides of the ocean, in boom times, when the factories and mills and business houses are at the peak of activity, there is a steady flow of population from the countryside to the cities But with the advent of slack times and the laying off of factory and mill and business workers, there is a gradual counter-flow or back-to-the-land movement. So it is a most opportune moment to present in this instalment of our "Success" series, a survey of the opportunities in scientific farming. Mr. Yates tells us many interesting things about present-day farming, and we certainly believe he has made out a strong case for the man who is going back to the land —THE EDITOR.

SCIENCE has invaded every realm of human endeavor and farming has been no exception Science is showing the way to better, bigger crops, healthier stock *and greater efficiency in farm management* The "rule-of-thumb" farmer is gradually becoming educated although he may not appreciate the fact The gospel of scientific farming, through the good work *of our Department of* Agriculture, is fast spreading and the farm is becoming more and more like an industry

The reader can feel that he is indebted to Dr H C Taylor, Chief of the Office of Farm Management, Department of Agriculture, for the information imparted in this article There is probably no man in the United States better qualified to give advice on this subject than Dr Taylor, who, before coming to the Department of Agriculture, was head of the Department of Agricultural Economics at the University of Wisconsin The author has taken the liberty directly to quote Dr. Taylor in many instances As the subject is such a difficult one to treat in the allowable space, the author felt that any original views he had on the subject would have to be subordinated to those of a man who knew a great deal more about the field

When Dr Taylor was asked what education he considered necessary to succeed in scientific farming he answered that, "a so-called 'higher' academic education is desirable but not essential There are great numbers of farmers who conduct their farms on a scientific basis, but who have not had the advantage of more than a common school education On the other hand, there are those who have completed courses in agricultural colleges but have not been able to make a success of farming In general it may be said that education neither creates nor destroys a good farmer The tendency is for education to improve both classes The essential thing is that the farmer understand the forces with which he has to deal and possess the wisdom to adjust his actions to his conditions Other things being equal, the college man will not only do better in this regard, but make a more helpful citizen"

The mention of education suggests the question of whether or not a man can succeed in scientific farming without attending college Anyone contemplating entering this field who cannot see the way clear to attending school may be encouraged by the fact that only a small percentage of the successful farmers in this country are college trained It is a mooted question whether or not these men would have been more successful had they possessed the advantage of a thorough college training It is possible that the greater part of them would have attained more success if they had a thorough training such as that offered by a few of the leading colleges of this country today

Statistics show that the percentage of college trained farmers is rapidly increasing There is probably greater opportunity for success for the self-trained man in this field than in any other Any wide-awake, alert young man with plenty of ambition and with a yearning for the invigorating outdoor life of the farm can succeed without attending college The garnering of the necessary knowledge for success cannot be accomplished in a year or in two or three years without practical experience

Farming is one thing that cannot be successfully taught by a correspondence school course or any amount of reading without the advantage of practical experience The young man desiring to succeed in this field should first get on a farm, whether it is his own or not, and then study should be started In following out a course of this kind one should remember that the Department of Agriculture can be depended upon for information along most any line of farming This department is devoted to research work and to the dissemination of information to the farmers of this country

The demand for men trained in scientific agriculture is increasing every year This demand is by no means confined to the operation of farms. It comes from State and Federal departments, agricultural colleges and universities, as well as from commercial firms that have to do with farm products.

When he was asked what he believed to be the necessary qualifications for a young man entering the field of scientific farming, Dr. Taylor answered: "The first qualification for scientific farming is farm training It is desirable, although perhaps not altogether necessary, that one who goes into farming should have been reared upon a farm or at least should have spent considerable time working upon one Other qualifications are, reasonably good health, business ability which involves sound judgment, a realization of one's limitation and the love for country life In general it may be said that the successful operation of a farm requires all those qualifications which make for a successful career in any other business or profession, with the one exception—that farming requires a closer application of those qualifications and gives greater freedom of action"

To one about to enter the scientific agricultural field the question of the length of time needed for training is an important one Dr. Taylor answers it in this way "As I have attempted to explain, a man may be a scientific farmer without having gained a knowledge of his scientific methods through academic training On the whole, however, the academic method is the quicker way of gaining this scientific knowledge A four-year course at a good agricultural college is desirable If it is not possible to obtain this, a two-year course may answer the purpose, although it will not take the place of the longer period of training where the work involved is highly technical It is often necessary for the one intending to take up a highly technical line of work to spend from one to three years in a graduate school"

The chap who cannot attend college should just keep on "plugging" until he feels that he has succeeded Ability varies so in different individuals, as well as the capacity for learning, that it would be difficult to say just how long it would take a man to become a successful scientific farmer outside of college Much would also depend upon whether he had had previous experience in farming. A man who had been brought up on a farm would have a tremendous advantage over a man brought up in the city although the city man does not present a hopeless case by any means

Do a great number of scientific farmers go into business for themselves? Dr. Taylor's answer to this important question follows: "Yes, although the demand for those trained in scientific agriculture by State and Federal institutions, agricultural colleges and universities, has been so great that the farm has not taken as many of these men as it is likely to take in the future. It is to be expected that as the agricultural colleges turn out more graduates, a greater percentage of them will return directly to the farm. On the other hand, it must be explained that one of the reasons why graduates of agricultural colleges turn to salaried positions, rather than going to the farm, is the fact that it requires considerable capital to actively engage in farming."

It is difficult to say just what the salary of a thoroughly experienced man in scientific agriculture can be It is one of those questions that can be answered largely by "it all depends." In scientific farming it is "determined by the amount some millionaire, farming by proxy, is willing to pay in order to get just the man he wants to run his farm." Of course, with salaries there must be considered the question of living expenses which are generally included. In general it may be said that there are few high salaried positions to be had in this field. On the other hand there is no definite limit to the amount that may be earned by a man in business for himself. This will be determined by the amount of land he has available and the nature of his crops

There is always need for specialists in every branch of scientific farming. A man may specialize in the raising and care of various kinds of stock, or he may specialize in wheat, corn or fruit.

Dr Taylor was asked what he thought of the college courses being offered in scientific farming. He said that he did not believe they were perfect any more than he believed that the college courses in any given field were perfect The courses are better now than they have been in the past and they seem to be continually improving

What should the ambition of every scientific farmer be? Dr Taylor answered this inspiringly when he said "To obtain a greater grasp and a more complete knowledge of his profession, to apply this knowledge to his own environment in such a manner as will make farming more profitable, and to become a leader in the establishing of better living conditions in the country."

Any farmer who uses the forces at his command—land, labor, capital and managerial ability—with a moderate degree of efficiency, is a benefactor to mankind. A scientific farmer is only scientific to the degree in which he makes efficient use of the above forces This being the case, it would necessarily follow that a scientific farmer is a greater benefactor to mankind than is the farmer who does not employ scientific methods.

The following information taken from a bulletin issued by the U S. Department of Agriculture will be of interest to those who are contemplating a farming career.

Agriculture is the greatest single line of industry in the nation. Since 1916 the value of its annual output has exceeded $20,000,000,000 while in 1919 the estimated value of crops, and of live stock and animal products totaled nearly $25,000,000,000, which is about the equivalent of our entire national debt. These figures, of course, do not represent net value, because much of the crop production is fed and marketed in the form of live stock, nor do they represent the net return of profit to the farmers, but merely the gross farm output

The value of farm buildings and equipment was reported in the 1910 census as $40,991,000,000. With the rise in value since the last census, and on basis of present prices, the value of farm property is now probably in excess of $80,000,000,000, five times the value of all the railroads in 1910, nearly 20 times the value of the iron and steel industry, nearly 40 times the value of the textile industry, and forty times the combined value of more than 75 distinct groups of miscellaneous industries. Except for the railroads, the value of live stock alone on farms on January 1, 1920, was several times greater than the capital valuation of any other single industry in the United States.

The 1910 census also shows that approximately 12,800,00 persons—the farmer himself and his hired help—were then employed in agriculture, 20 per cent more than in all manufacturing and mechanical industries combined; 372 per cent more than in transportation, 242 per cent more than all the bankers, merchants, wholesalers, jobbers and retailers; and 1281 per cent more than the number engaged in the extraction of minerals. It is estimated that at the present time there are approximately 7,000,000 farmers in the United States and that the number of adult male farmers and hired farm helpers is probably about 14,000,000. More people are engaged in farming, and are directly or indirectly dependent upon farming for a living than any other single industry in the country.

These facts emphasize the fundamental importance of agriculture. Unless agriculture prospers, other industries cannot hope to prosper—and agriculture cannot prosper unless the individual farm business is profitable.

The Train Director and His Work

How Hundreds of Trains Are Handled In and Out of a Giant Railroad Terminal

KEEPING the terminals clear so as to take care of incoming and outgoing trains is the main operating problem of a railroad. For with a four-track main line and an efficient system of automatic signals that permits of reducing the headway to a minimum, there is practically no limit to the amount of train traffic that can be handled, if the terminals are ready to receive that traffic.

How hundreds of trains in and out of a large terminal are handled without hitch or mishap inspired the cover illustration of this issue. In the Grand Central Terminal, in the heart of New York City, something like six hundred passenger trains are handled daily. Made up into a single train, this traffic would represent a train forty-eight miles long. These trains must be assigned to the proper tracks in the terminal with all the switching and signaling that such operations involve. And if the long obsolete practice of using stand switches with individual switchmen were still in vogue, it would require many hundred men continually on duty to operate these stands; furthermore, beyond the layman's possible reasoning, it would also require a corps of men to direct the switch tenders and the trains so that they might be run over the tracks and through the switches with safety and dispatch The present method of operating the switches and crossovers and signals from a central point, known as an interlocking station, has enabled all these operations over an extensive area to be controlled by a small number of men headed by a "director," as shown in our cover illustration.

Still further to safeguard and facilitate train movements, a device known as a signal is placed at specified locations by which information is given to the men driving the trains as to the direction they will take and whether it is safe to proceed beyond the signal. In other words, the means used to operate the switches and signals jointly take the place of a man, were he located at the switch and operated the switch with a switch stand.

The operation of the switches and signals is under the supervision of the "director" as already stated, and the actuating of the various devices is made possible by the use of an electric motor. The motor of each switch and signal is connected by wires to levers assembled in a machine termed an interlocking machine. The motors are run by current supplied by storage battery—a positive source of power The levers are pulled by men called "levermen," who work under the instructions of the "director."

The interlocking stations of the Grand Central terminal are buildings or houses where the interlocking machine is located to protect it from the elements The interlocking machine comprises a large number of cabinets which mount several batteries of levers, the manipulation of which operate certain signals and switches The mechanism of the interlocking machine is such that it is mechanically impossible to operate any lever except as arranged, otherwise collisions by the giving of wrong signals might result The checking or locking of levers is accomplished by moving slides attached to the pistol-grip-like levers used to open and close the circuits that operate the motors for the switches and signals

Now all trains reach the Grand Central terminal over the four tracks located under Park Avenue—those from the Hudson River towns, the West, Canada and the Adirondacks joining those from the Bronx, Berkshires, and New England at 149th Street in Park Avenue, or five miles north of the station proper, at a point known as the Mott Haven junction

The dispatching or handling of trains through the medium of interlocking devices by "directors" and levermen is very simple Since the construction and location of the large interlocking stations make it possible only to see the trains arriving and departing from the main yard connections, the "director" assumes the rôle of a general manager of trains and interlocking movements, sitting at a desk to which are fastened animated diagrams showing the complete track layout over which he has supervision, as well as showing, by means of tiny electric lamps, which sections are occupied and which are vacant The levermen who operate the interlocking machine also have positive information as to the position of switches and signals by means of tiny light indicators

A train for the terminal from Chicago or any other point is announced to the "director" at the Grand Central station by the "director" at the Mott Haven junction, five miles distant The announcement is made by means of a special annunciator, shown to the left of the "director" in our cover illustration. This annunciator, by means of small electric lights, indicates the kind of train coming through, and on what track, in order that the "director" at the terminal can prepare to receive it It must be remembered that as many as a dozen trains are moving at the same time in the same or perchance different directions

By pushing a button at his end the terminal "director" can reset the annunciator at the Mott Haven 'director's" post, thus indicating that he is prepared to take care of the train The "director" calls out to the levermen the various orders for setting switches and signals, and watches the progress of the incoming and outgoing trains on the animated track layout plan in front of him The levermen, too, know when the way is clear, for they have small indicator lights for each lever The reverse operation is followed for outgoing trains

All in all, the trains are guided to and from the terminal with clocklike precision under the control of the "directors' working at their pushbuttons and kept in touch with train movements by means of animated track layout diagrams

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Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Irish Monorail

To the Editor of the SCIENTIFIC AMERICAN:

Referring to your issue of Nov. 20, 1920, I would say that the "curious little monorail road in Ireland," described on page 515, does not run from Killarney to Ballybunnion (not Bally Bunion) It runs from Listowel to Ballybunnion, a distance of 9 miles Killarney is some 40 miles by rail to the south of Listowel This curious little railway is, I have understood, the conception of a Frenchman. HALDEMAN O'CONNOR

Harrisburg, Pa

A Question of Biology

To the Editor of the SCIENTIFIC AMERICAN:

As I am on a houseboat trip in the beautiful Fu River Valley in interior Kiangsi, I have a little leisure to look over the 1920 file of your valuable paper, which I have with me.

In your number of April 10, 1920, Dr. Conant discusses at some length an article in the Nov. 15, 1919, issue on the question of the death of metazoa and the immortality of protozoa. There seems to be a little confusion of terms taken for granted, and this interferes a bit with the very beginning of the argument. This confusion is betrayed in the very statement of the question.

The confusion arises from the fact that the protozoan combines in a single cell all the functions of its life, while the metazoan shows a division of parts and a separation, more or less complete, of the vital functions. Thus we find that in discussing metazoan life we can distinguish clearly between individual life and racial life. The metazoan has certain cells set apart expressly for the purpose of prolonging racial existence and these cells are, as it were, fed and protected by the rest of the cells of the body. In the protozoan the reproductive function, the feeding function, the protecting function, and all the other functions are carried on in the one cell.

From the standpoint of individual life it makes little difference whether we are considering a protozoan or a metazoan, provided we make the distinction outlined above. The individual can cease its existence by accident (disease, old age, weakness preyed upon by slight and obscure diseases or accident, or physical violence such as is done by chemical or mechanical means), and in metazoa this is practically the only method of bringing life to an end Death from pure old age seems to be largely a fiction, since, while we can imagine it easily enough it is hard to find a scientifically pure example.

In protozoa the individual may cease its individual existence by fission, that is, divison into two new and separate individuals, or by conjugation, which is union with another individual s reproductive elements, and is immediately followed by fission Whether the individual ceases its separate existence on conjugation or not, it does immediately afterward in fission, so the question is a bit academic

The protozoan racial life is prolonged by the fission and conjugation-fission processes, while the metazoan racial life is prolonged by the reproductive act, which is essentially the same as the protozoan conjugation, that is, the union of two cells—at any rate the union of selected parts of two cells, followed by division and leading to the production of a brand-new individual

A race of protozoans kept from conjugation becomes subject to certain changes which show themselves in the production of freaks and weakened individuals, and the whole colony suffers a process of degradation to the condition familiar in metazoans as old age Conjugation seems to bring about a rejuvenation and immediately makes possible a new and perfect race with youth and strength.

In this way it is possible to have under experimental conditions a real separation of the protozoan life into (1) individual and (2) racial life, and when this is done it is easily seen that there is no essential difference between the lease held on life by protozoans and metazoans.

In either case the individual comes to its end by disease, which is a form of accident, or by violence of some kind, which is also accident, and occasionally the individual lives so long that in the weakening due to old age it is hard, perhaps impossible, to pick out the particular violence causing the death, and theoretically at least it might be possible to have death due to the weakening of old age alone

In either case, too, the racial life is, so far as we know, eternal, with the exception that a particular branch of the race may suffer extinction by accident, in the metazoan by the death of the individual before the reproductive process results in the formation of a new individual, and in the protozoan by the same thing, which reduces in expression to the death of the individual at any stage in its existence, since it is potentially able to reproduce at any age.

Dr Conant has left the question I have been discussing and proceeds with a discussion of ultimate forces I have nothing to say about the remainder of his discussion, and am seeking merely to outline what I conceive to be the correct parallel between protozoan and metazoan life and death FRED R. BROWN.

Nanchang China

Plane vs. Bird

To the Editor of the SCIENTIFIC AMERICAN:

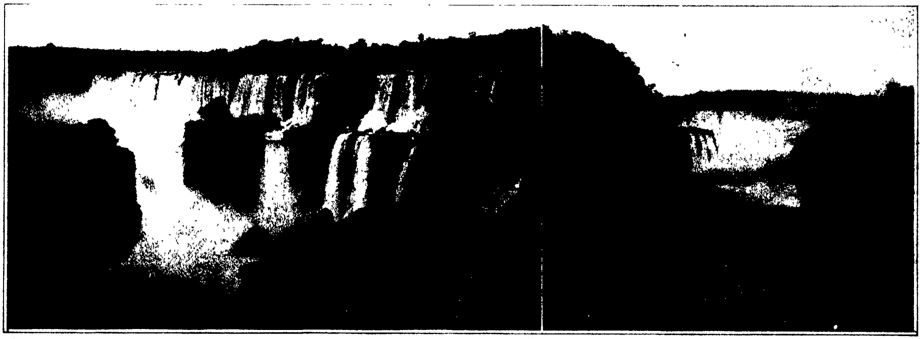
Although mechanical flight has been perfected to a degree where its practicability can no longer be doubted it cannot be stated that the principles governing airplane flight and bird flight are the same In propelling the airplane—in pushing or pulling this heavier-than air machine forward by rapidly rotating propellers, man is utilizing the air resistance force in an entirely different manner than the bird. The forces brought into play by the flying bird are, first, gravitation, second, air resistance, third, the muscular energy of the bird The first produces the motion of the bird in air, the second furnishes the medium whereby the direction of motion is altered and the third controls the direction In attributing the motion of the bird in air to its weight as the force of gravity thereby represented it should be remembered that this motion does not differ from the falling motion of any other heavier than-air body The wingless body of a bird unsupported in mid-air is in a state of motion for the same reason the winged bird moves in this medium, the winged bird alters the direction of motion by utilizing the air resistance against these surfaces does not however create motion itself The airplane gliding from a height with propellers stopped changes the direction of a falling motion, to say that the bird propels itself forward by its wings is equal to saying the supporting surfaces propel the gliding airplane The bird converts the descending glide of the rigidly constructed airplane into a prolonged glide it increases the air resistance to a degree equal to its weight by beating its wings, establishing thereby a horizontal gliding motion The cause of its motion however remains identical with that of the gliding airplane. A. HUTH

New York.

Hydroelectric Power in Argentina

Will the Iguazu Falls Provide the Solution of a Grave Fuel Problem?

By Leonard Matters


Two views of the Iguazu Falls in Argentine Republic, the latter view being one looking up the gorge to the central fall. Seventy thousand cubic feet of water are now running to waste every second

WHEN Mother Nature destined the vast territory known as Argentina to be one of the greatest agricultural countries in the world, she showered her favors upon the land giving it a climate that is like one eternal spring and so enriching the soil that not yet, after a century of close cultivation in the older farming areas, has it been found necessary to restore fertility by the use of artificial manures.

But having done all this, Nature stopped short, considering (one might suppose) that she had done enough, and deciding that if the Argentines wished to develop secondary and manufacturing industries they must not count upon her. Not a ton of iron, not a ton of coal, did she bestow—or if she did then her bounty has not so far been discovered anywhere in the republic within range of the big cities. There is coal and there is iron, but it might just as well not exist as be where it is—hundreds of miles beyond economical working and transportation.

Nevertheless the Argentines who are born optimists and a most ambitious people are determined that manufacturing industries shall be developed. Iron and other metals they can import. The problem is one of power. Coal costs just now about fifty dollars gold a ton, and every ton must be imported. At that price, and with no guarantee of regular or sufficient supplies from countries where calamitous strikes are always liable to occur, coal cannot be looked to as a factor in manufacturing. The oil fields of Comodoro Rivadavia cannot yet supply more than a fraction of the liquid fuel the country consumes, and until a railway is built Comodoro Rivadavia will always be five days by steamship from Buenos Aires. In the last five years the shortage of coal has been made good by burning quebracho wood, and feeding scores of thousands of tons of maize into furnaces. This cannot go on. The near-by forests have been cut out, and the wood cutters are daily retreating farther and farther inland, making the cost of wood higher and higher until even now the price is not far below that of imported coal. Argentina's dreams of a great manufacturing future may be entirely unwarranted when we think of the superior advantages which the United States and Europe possess and which enable them to produce what the republic needs for less than those needs could ever be supplied by artificially created industries in Argentina but the Argentine will not admit it. His optimism and ambition tell him he can become a manufacturer if—and this is the only problem he will agree exists—he can solve the problem of power production.

That is why, in the last five years or so, so much has been heard of the project for utilizing the immense waterways of the republic to generate electric power. That is why the name of the Iguazu has been advertised abroad, and the falls to which the name applies have in a sense been discovered to the world. And they are falls worth the world's notice if for no other reason that they have only two rivals—Niagara and the Victoria Falls on the Zambesi.

When Nature came to her decision about Argentina's future she evidently forgot that in creating the Iguazu she was providing the means whereby something more than an agricultural destiny might be realized. Possibly she did not forget it. Possibly she was well aware of the potentialities of such a physical phenomenon in the land, and merely desired that if the Argentines would determine to become manufacturers, then in the Iguazu lay the problem for solution. And a tough problem it is, though quite airily spoken of. To make use of the falls is going to be one of the biggest engineering jobs of the future, and a future that is perhaps a very distant one.

Up in the hinterland of South America, where the frontiers of Argentina, Brazil and Paraguay run together, is the Iguazu River. The Brazilians spell it "Iguassu." The Argentines spell it "Iguasu," or "Yguasu." This river discharges into the Upper Parana, the Parana being a mighty waterway flowing in its turn into the Rio de la Plata and constituting a navigable stream, hundreds of miles long up which ocean going vessels proceed for a considerable distance. The Parana is the Mississippi of Argentina and Paraguay. At a point 750 miles from Buenos Aires are the Iguazu Falls. They could hardly be more inaccessible than they are, unless they were up in the heart of the Amazon forests, which accounts for the fact that not one in ten thousand Argentines has ever seen them, and though tours to the falls are advertised in Buenos Aires only a few persons visit them every year. To get to the falls requires a long railway journey, or the slower voyage up the Parana. In either case the trip calls for a second stage by small river steamer, to within about 20 miles of the Iguazu, and a final stage by mule cart, or more recently by automobile. But those who have been there declare the sight to be worth all the trouble—a greater spectacle than Niagara itself.

The river flows deep and swift. Twenty miles above its mouth its width lessens, and the waters are compressed. The river takes a sharp turn round a horseshoe shaped course, and rushing through numerous islands which bar its way, and spread its waters, it plunges sheer down a precipice 230 feet deep. Once over the falls the water is again compressed in a narrow gorge through which the torrent roars and boils on its way to calmer reaches of the Upper Parana. It is estimated that in the wet season the volume of water pouring over the falls is equal to 70,000 cubic feet per second. The Iguazu is not fed by mountain streams, carrying off melting snows. It is a huge drain for a belt of country in which heavy sub-tropical rains fall. The maximum flow is in the rainy season, and the minimum in the dry period when the volume of water passing the falls becomes reduced to no more than 7,000 cubic feet per second.

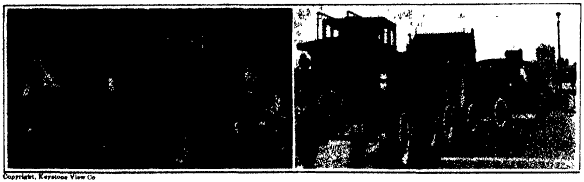
Here then is a tremendous force that engineers would like to harness and utilize. If the Iguazu were in Europe or the United States, or even if it were still in Argentina, but closer to the settled areas, it would have been put to effective use long ago. The power is there, but a double problem presents itself when consideration of how that power is to be taken advantage of is entered upon. Can this power be transmitted to where it can be used? This question electrical experts alone can answer. If it can be transmitted, is the cost of the undertaking going to leave any profit? In other words, will the cost of the power, when it is brought where it is needed, be too great to permit of its use in place of the power now generated from imported fuel? This double-sided problem is just now exercising the minds of the experts of the Argentine Government. Schemes for developing hydroelectric power at the Iguazu Falls are always being discussed in Buenos Aires. So far as the author can ascertain a thorough investigation of the proposition has never been made by any capable hydroelectric engineer. Such experts are hardly to be found in Argentina for the simple reason that up to the moment there has been very little demand for their services. Water power for generating electrical energy is something that has scarcely been studied in the republic, and the plants already established could be numbered on the fingers of one hand.

It is claimed, however, that Argentine Government engineers have now conducted a careful investigation of the Iguazu proposition and the announcement that their report will be published shortly has inspired this article. In a summary of what will appear in this report, which has been printed in the Buenos Aires newspapers, the Government engineers are credited with the statement that in its technical aspects the scheme for utilizing the power of the falls is feasible, though they will not commit themselves on its economic possibilities. The normal energy to be generated under the scheme investigated by the engineers is given as 125,000 kilowatts, derived from a battery of turbines of the "Francis" type, developing 23,000 horsepower. There would be twelve of these turbines constantly at work, with two more in reserve. For ten months of the year the normal supply of 125,000 kilowatts could be relied on, but to insure its constancy for the full year a dam would have to be constructed across the river above the falls. In their report the engineers deal also with a subsidiary power station on the River Uruguay at a place called Salto Grande where the rapids would give a head of water of about 75 feet, and another 50,000 kilowatts could be generated. The cost of the entire scheme is estimated to be between $60,000,000 and $70,000,000 gold.

(Continued on page 340)

A Make-Believe Freight Train for Publicity Purposes

BY dressing up a light automobile and two trailers to represent a steam locomotive and two freight cars, a Western pneumatic tire manufacturer has obtained the superlative degree of publicity—if there be such a thing At any rate, his make-believe train has been operating over California highways, hauling many loads of tires and attracting wide attention wherever it has chanced to pass. The trailers are of the tracking type; that is to say, the trailer wheels will track behind the wheels of the tractor, so that even the sharpest street corners can be turned without difficulty and the train can make its way through the densest traffic without difficulty. Chime bells, operated by electricity and played by a lady musician stationed in the caboose serve to draw the attention of motorists and pedestrians alike.

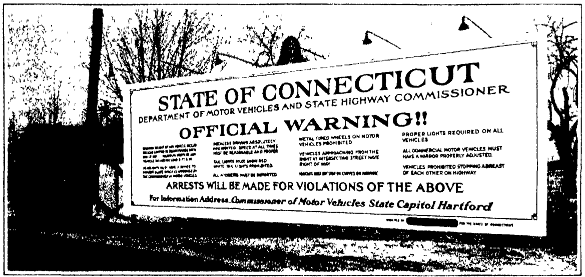


Copyright, Keystone View Co

Two views of the make-believe freight train employed by a tire manufacturer for publicity purposes

Motor Laws at a Glance

THE State of Connecticut has decided to make its motor laws quite plain to everyone having opportunity to use its roads To this end there have been erected at various important points large painted billboards of the kind shown in the accompanying illustration, stating in detail what the motor laws of the State mean when translated into plain English.


STATE OF CONNECTICUT
DEPARTMENT OF MOTOR VEHICLES AND STATE HIGHWAY COMMISSIONER
OFFICIAL WARNING!!
METAL TIRED WHEELS ON MOTOR VEHICLES PROHIBITED
VEHICLES APPROACHING FROM THE RIGHT AT INTERSECTING STREET HAVE RIGHT OF WAY
PROPER LIGHTS REQUIRED ON ALL VEHICLES
ALL COMMERCIAL MOTOR VEHICLES MUST HAVE A MIRROR PROPERLY ADJUSTED
VEHICLES PROHIBITED STOPPING ABREAST OF EACH OTHER ON HIGHWAY
ARRESTS WILL BE MADE FOR VIOLATIONS OF THE ABOVE
For Information Address Commissioner of Motor Vehicles State Capitol Hartford

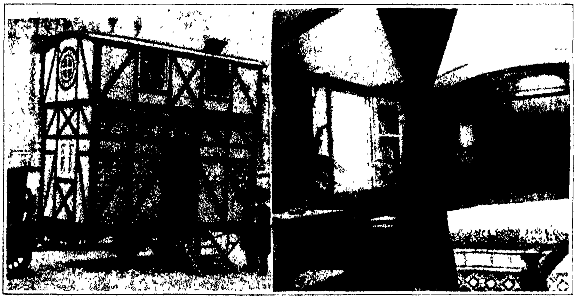
Copyright, Publishers Photo Service

When confronted by such signs as this the motorist can hardly plead ignorance of the motor laws

A Home That Goes Anywhere

PARISIANS were startled recently when they saw a small, two-story house on wheels being hauled through the city streets by a motor car And they were still more startled when the inventor invited them to inspect the interior, thus revealing a surprisingly large range of accommodations for so small a domicile

The house mounted on wheels while being transported, consists of four rooms, including kitchen, heating equipment, miniature staircase and modern conveniences The house is eight feet wide and fifteen feet high, but by means of telescoping walls it can be brought down to 9½ feet in height to facilitate transportation. The French Government has ordered a considerable number of these portable houses for the inhabitants of the devastated regions, inasmuch as they are being turned out for $835 complete



General view of the house on wheels and a corner of the comfortable bed room

Storing Gravel a Different Way

LACK of storage space in building an industrial plant in an Eastern city recently resulted in a novel method of storing gravel. It was necessary to maintain a high pile of gravel because of the unreliability of delivery by truck and because of the high cost of wheelbarrowing

A wooden bin with a gate and chute in the lower end was constructed in front of the mixer hopper When the mixer hopper was being elevated to discharge into the mixer the chute to the bin was raised out of the way as it was hinged to the gate A plank incline was built from the front down to the pile of gravel A snatch block was fastened overhead to the frame of the concreting tower A cable through the block and through one lower down on the tower was passed over a drum of the hoisting engine The other end of the cable was fastened to an ordinary drag scraper on the gravel pile

Spreading out in the shape of a fan to the street from the inclined planks, the gravel was dumped from the delivering trucks The scraper was guided into the pile and the hoisting engine pulled it up the incline where it was dumped into the bin From the bin the rock was taken out as required in mixing operations.

By means of an ordinary drag scraper the gravel is scooped up to the bin

Two Ways to Test "Oil"

TRAMPING through the woods, the close observer sometimes notices a film-like covering on water, particularly stagnant water, which looks as though it might be oil Oil is a fantastic topic nowadays, subject as it is to spectacular discovery, bringing great wealth, and these bluish films on pools naturally often suggest the thought that petroleum is near There are simple tests—even a boy can make them—which will enable the curious one to get at the root of the matter

In swampy spots bacterial scums are common Sometimes they are strongly suggestive of oil To determine whether a scum is bacterial or oil, take a stick and gently break the scum apart Now watch its behavior The bacterial scum will break up into patches If there is movement to the water, it will float away It will not join again Oil scum, on the other hand if gently stirred or broken, will spread, then come together This test is vouched for by geologists as excellent

If the scum comes together, the next test is to gather up some, enough for a drop, and let it fall on a hot stove cover The smell of the substance in contact with the hot cover is a further test If it's petroleum it will smell of it

All that looks like oil is not oil The oil-like film noticed on the still, swampy pool is probably just a bacterial scum But one can put the matter to a test, and know for sure

A Hospital for Mail Bags

How the U. S. Post Office Department Operates a Factory for Making and Repairing Mail Bags

By S. R. Winters

UNCLE SAM, the administrator, diplomat, guardian of the Treasury and numerous other titles befitting the dignity of his position, assumes a comparatively new rôle—that of a manufacturer. His specialty is the production of mail bags. The government-owned building, a steel and concrete manufacturing establishment representing an original investment of $200,000, is situated on the corner of Fifth and W Streets, Northeast, Washington, D. C., and in structural design is a model for the purpose. Approximately 200 men and women are employed in making and repairing mail sacks, and not unlike other busy manufacturers engaged in quantity production, employees of Uncle Sam work two shifts of eight hours each.

Prior to 1918 the containers used in hauling letters and parcel post from coast to coast, as well as to and from thousands of intermediary points, were manufactured by commercial concerns. Awards were made to the lowest bidder. During 1919 the Federal Government, securely entrenched in its new manufacturing establishment, made 472,350 sacks within the specified time, at a saving, according to claims of the United States Postoffice Department, of $53,530.22 under the lowest bid received from commercial enterprises. For the corresponding period of time, 2,532,632 bags were repaired in the salvage department of the mail equipment shops, at a trifling cost of 7.4 cents apiece. Cord fasteners, grommets, and other metal attachments are supplied in this government workshop, the cord used in closing bags and pouches entailing the consumption of 70 carloads of twine during the past fiscal year. Supplementary to meeting its own requirements, the mail equipment shops manufactured 10,368 pieces of equipment and attachments for other government departments and the postal service of the Philippine Islands.

A light weight canvas has been recently adopted for making sacks, the change from heavy quality resulting in an economy of $171,769.50 in a year, it is estimated. Number 8, 32-inch duck cloth is used for making standard number one domestic mail bags, the Post Office Department buying the material from manufacturers in rolls varying from 200 to 500 yards. These immense bolts of cloth are placed on a rack five rolls at a time and unrolled by hand on to a table, the five thicknesses being cut at one time into the proper length. Ninety-three and one-half inches of cloth are required to make a domestic mail sack. The canvas, having been cut into mail bag proportions, is conveyed to the stencilling department, where Uncle Sam puts his imprint, "Domestic, U. S. Mail (1)." The label makes it unmistakable that it is not a spurious product and by the numbering process differentiates between different kinds of sacks and pouches. One operator can stencil 1,200 bags in an 8 hour day.

When the writer visited the mail equipment shops a machine, designed by F. A. Lazenby, of Baltimore, was being installed for the specific purpose of displacing hand labor with machinery in stencilling mail sacks. The apparatus, the first of its kind to be built and for the special use of the Post Office Department, is supposed to cut, fold, and stack the canvas for the bags. If practical application justifies the claims of its inventor, the mechanism will displace the services of eight men. A mechanic and helper operate the machine. The canvas is fed from a large roll supported on a rack, the cloth passing under a revolving drum bearing printing dies containing the desired wording. The drum is equipped with brass strips which regulate the cut to any specified length. Following this is an automatic knife which is operated by cam action, from which it feeds out over a moving table which consists of two short conveyors. The canvas is fed out on these conveyors until the bag is centered over a folding blade which automatically rises. This operation starts a center fold of the canvas through two rolls which changes the course of the bag on to an incline belt conveyor which makes delivery to a stacking cradle. The machine extends over a distance of 20 feet, and weighs about 8,000 pounds.

Whether cut, folded, and stacked by hand or machinery, the succeeding process in the manufacturing of containers—serving alike the transmission of the letters of the lovelorn maid and the stern business man—is the distribution of the canvas to union special sewing machines. These units, operating at a rapid speed under the manipulation of women, first apply the seams to both sides of the sack at a single operation. Each woman operator is capable of completing the seaming process of 300 mail sacks in eight hours, with 350 bags being the creditable performance of unusual speed. A quick transition is that of transferring the bags from the seamer to the hemmer, the two machines being located on the same table. Each operator inserts the hems in from 400 to 500 containers in an 8-hour day.

Stated in accordance with the logical sequence of things, the grommeting process is then recognized, that is, eyelets are placed in the sacks. Thirteen metal grommets are so spaced in the hem of the bag as to facilitate its suspension in any standard rack of the postal service, taking for granted that the container will be subject to innumerable vicissitudes in a devious journey, mayhap, across the continent. The insertion of the grommets is accomplished, first, by the use of a wired punch press which penetrates at one time all the holes necessary for the installation of grommets. As many as 4,000 sacks can be punched by an expert operator, working eight hours. The process of placing the eyelets is completed by inserting the metal grommet (which consists of a flanged tube and a ring) in the hole perforated in the sack, using a small punch press operated by boys ranging from 16 to 21 years of age. Each boy, working for a minimum wage of $2.88 for an 8-hour day, is capable of inserting grommets in from 300 to 550 bags.

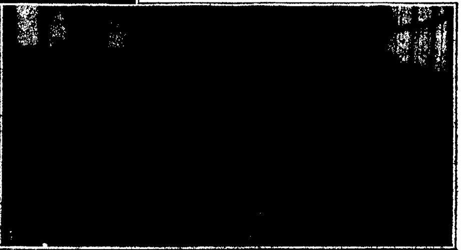
Once grommeted, the mail containers are equipped with lacing cord and cord fasteners. The work is negotiated by women, one of whom labors daily at the job in spite of having the misfortune of being bereft of eyesight. Described as "stringers," each operator is capable of inserting 300 cord fasteners during a working day. Clamps, clipped on with a pair of shears, are put on the ends of the cord to prevent the material from fraying. Thus, Uncle Sam in the rôle of manufacturer, completes the process of making mail containers, the capacity of the mail equipment shops being 4,000 new bags when two eight-hour shifts constitute the production forces. The containers are conveyed to the second floor of the building, packed in units of 20 bags each, and labeled with the name of the office of its destination. Shipping instructions are furnished by the railway mail service, which has jurisdiction over the distribution of mail equipment. Bulk lots of the sacks are loaded on motor trucks and transported to the depot where mail cars usually distribute them in wholesale consignments to principal cities like New York, Chicago and St. Louis.

Subject to the rough handling on railways and at the stations and post offices, the life of a mail sack is of indeterminate length. Barely possibly one may weather the stress of use for 15 or 20 years or more likely the new sack on its second journey has to be consigned to the repair shop. The life of the average sack is computed to be only four years. Obviously, Uncle Sam needs a repair shop as well as a manufacturing establishment—in fact, a salvage department operates in conjunction with the latter. Approximately 10,000 sacks are received daily at the mail equipment shops in need of "doctoring," the mishaps varying from a ripped seam to a decapitated head. Salvaging is practiced as such a fine art that two half bags may be refashioned into a usable container. Where darning only is necessary, the repair machine rescues 160 bags a day, whereas patches can be placed at the rate of 80 every 16 hours.

Defective sacks, or "bums" as they are picturesquely described, necessarily accumulate dust as they are thrown in a pounding fashion from trains and otherwise subjected to ill treatment at stations and post

(Continued on page 340)

1



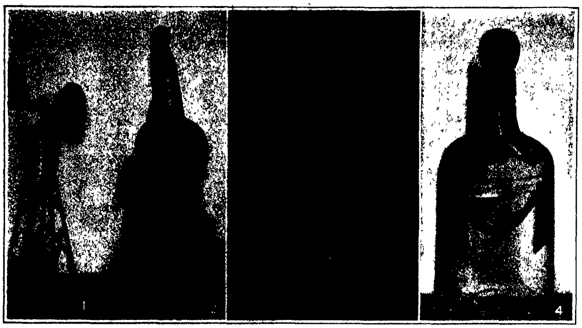
1. A section of the mail equipment shops where "bum" mail bags are salvaged. Each machine repairs 160 bags a day, or places 80 patches. 2. This machine punches 13 holes at a single operation, for the placing of grommets or eyelets in mail bags. Before this mechanism was designed by the mail equipment shops, one hole at a time was punched. 3. General interior view of the mail equipment shops, where mail sacks are made and repaired by sewing machines

Activities in the mail equipment shops, where mail bags are repaired for further service

The Whittler's Museum

MR. G. E. WILLIAMSON, of Los Angeles, takes his pen in hand to controvert the suggestion made in our issue of August 7th last, that the bunch of interlocking rings there illustrated as emanating from the facile knife of Mr. A. T. Cook represents the last word in whittling stunts. Mr. Williamson is a good deal of a whittler himself, as the exhibits which he sends and which we reproduce here attest.

The little windmill is cut, with the exception of the flat base, from a single piece of wood 1 by 2 by 22 inches. The mill turns on the tower, and the wheel turns independently. We gather from Mr. Williamson's description that in addition to actual cutting, he permits himself to bend the uprights, etc., into the desired positions. The miniature violin which stands beside the mill is another admirable sample of the gentle art of skilled whittling.



1. Windmill cut from a single piece, with the exception of the base. 2 Viola whittled entirely from wood that an instrument maker would have rejected. 3. A collection of interlocking rings, chains, and shears and pliers with real joints, each item cut from a single piece of wood. 4. A curious bottle assembly. the knife being too fat to be inserted in the bottle closed and too long when opened, yet there it is

A few surprising tricks of the whittler's trade

The real tricks of Mr Williamson's trade however are the pieces attached to the cardboard stand which form the background of our second picture The bunch of interlocking rings comprises 16 rings, each of which passes through all the others. These are cut from a block of wood 6 by 6 by 1¾ inches, and represent a small edition of Mr. Williamson's masterpiece — a group of 50 rings cut from a block 8 by 8 by 15

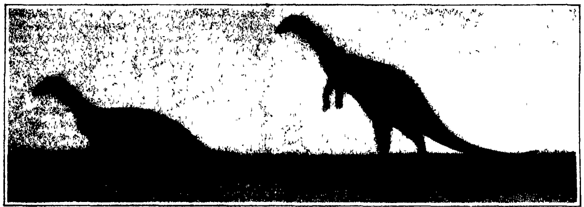
The master whittler cuts chains in twelve different patterns. From a block 6 by 6 by 2 inches he has cut an endless chain 9 feet long From a stick 2 by 2 by 30 inches he turns out a chain every link of which runs through twelve other links, or twenty others, at pleasure. He considers the shears to be the most complicated joint he has ever cut, since each blade passes through the other, while they function perfectly. The pliers likewise "work" as pliers ought.

In addition to his ordinary whittling stunts, Mr. Williamson does a lot of "bottle tricks," which means the assembling of complicated articles inside bottles. He regards as his masterpiece in this class a barrel 3 inches in diameter and 4 inches high, having 16 staves, 4 pieces in each head, and 6 hoops each nailed on with 4 nails; the entire outfit assembled inside a quart whisky bottle.

Another curiosity is the bottle assembly which we illustrate. The knife was too fat to go into the bottle closed, and too long opened; so the first two blades were closed after being inserted to allow the last two to enter, after which the first two were reopened. It goes without saying that the cords suspending the knife were put in place and tied inside the bottle.

Fossil Footprints of Texas

A LETTER to the Smithsonian Institution from Mr. George P. Bessent of Glen Rose, Texas, tells of the discovery in a rock formation near that place of a considerable number of large three-toed footprints These are of great scientific interest since they are the first fossil tracks to be reported from the State of Texas, and also because they definitely record the occurrence in that region of some large animal whose presence there in Lower Cretaceous times was previously unknown to scientists.



Herbivorous dinosaurs of primitive type restored from the data furnished by their footprints

With Mr Bessent's kind permission we are enabled to reproduce here a photograph of four of these footprints, showing how they occur in the rock. Quoting from his letter he says: "There are seven tracks in the bed of two forks of a little branch, and we found more by digging in the banks on each side Other footprints have been unearthed until we have a total of thirteen. One of these tracks was buried under about 8 feet of rock and soil The owner of the land will not allow any of the tracks to be taken up at least for the present"

A sketch enclosed in the above-mentioned letter shows the manner of their occurrence in a long single row which if the point of land between the forks of the stream bed was excavated would undoubtedly form one continuous series of tracks A full-sized sketch of one of these tracks shows that it had a greatest length of 14 inches, and that the toes had a spread of 13½ inches The toes are sunk three inches deep into the rock The tracks, Mr Bessent says, "are about four feet apart," thus in thirteen steps the animal that made them covered a distance of 52 feet

A comparison of these foot impressions with others whose origin has pretty certainly been determined through careful and detailed study, shows them to be so alike as to leave but little doubt that they were made by similar large, three-toed bipedal reptiles, known as dinosaurs, but as to which particular kind of dinosaur was responsible for the tracks is not so easily determined The best key to these ancient hieroglyphics would of course be the discovery of the actual skeletal remains associated with the footprints, or if found elsewhere, in a rock formation of equivalent age *Unfortunately in this case no* fossil bones of an animal of large enough size to have made these tracks has ever been found in Texas or elsewhere in rocks of equivalent geological age, so that at present we cannot expect any help from that source in solving this riddle of the rocks

The footprints with which they have been compared and to which reference has been made are those found in the valley of the Connecticut River in New England, a region that has long been famous for the abundance of four of these footprints, found there, and the excellence of their preservation The studies by the late President Edward Hitchcock of Amherst College resulted in the description and publication of more than 100 kinds of track-making organisms At first these were thought to be bird tracks, but this idea was largely dispelled under a more critical examination which showed the presence of dragging tails, small fore feet and impressions of

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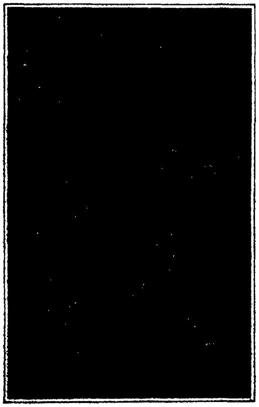
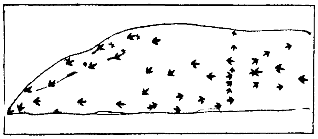
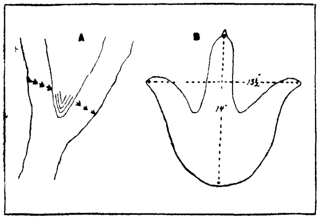


Fossil footprints found in the rock near Glen Rose, Texas. These footprints occur in rock that has been uncovered



Footprints of an herbivorous dinosaur showing where the animal rested (Amherst collection)



A. Sketch showing trail of fossil footprints crossing the two forks of a stream bed. B. Drawing showing the shape and dimensions of the tracks

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

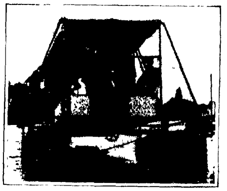
Walking stick that may be converted into golf stick by screwing on proper club head

Making the Golf Stick and Walking Stick One

FOR the business man who occasionally likes to get away from the routine of his work in order to enjoy a game of golf an enthusiastic British golfer, J E Wilson, has invented the combination walking stick and golf stick depicted in the accompanying illustration Normally the stick is a walking stick with a metal end piece However, by screwing on any one of the three attachments that are carried in the pocket, the stick becomes a putting cleek, iron, or a mashie niblick The golfer should be interested in this interchangeability, even if the possibility of converting his midiron into a cane does not appeal to him

London's Mystery Ship

THE mysterious craft shown in the accompanying view has aroused the curiosity of many Londoners of late The inventor F G Creed, has not volunteered any information, hence it is impossible to do more than surmise what he has aimed at in this queer craft Suffice it to say that this boat, if such it can be called, consists of a pair of pontoons mounting a staunch framework of steel piping, and equipped with a four-cylinder gasoline engine Presumably, the propulsive agent is a marine screw or propeller instead of an air propeller, and the idea back of the craft is to develop high speeds with relatively low power

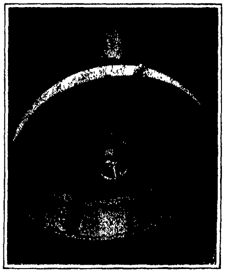


Odd craft which has recently appeared on the Thames and attracted attention of Londoners

A Shadowless Light for the Operating Room

SATISFACTORY illumination is one of the problems confronting the modern surgeon For one thing the illumination must be concentrated and powerful, but still more important it is to have a shadowless illumination if possible The hands and instruments of the surgeon and his assistants have a most awkward tendency to get in the way of the source of illumination and shut off the light at the very point where it is required most urgently

It has remained for a French professor, M L Verain, to develop a special lamp for the operating room This lamp is at once powerful and almost shadowless thus fulfilling the main requisites The way M Verain has accomplished these ends may be noted by studying the accompanying illustration A gas-filled high-efficiency incandescent lamp is placed in a cylindrical lens cell of the same general design as the lenses of the usual mariner's lights This lens system serves to project the rays of light sideways where they come into contact with fifty mirrors arranged as sectors around the inside of a large metal bowl reflector These mirrors are tilted at such an angle as to throw the reflected beams of light downward, thus forming a concentrated circle of light The area of this circle of light may be increased or decreased by varying the distance between the light source and the surface on which the rays are concentrated And as the light is reflected from fifty mirrors, if the surgeon's hands or instruments cut off part of the rays there are others that are not cut off and thus supply the required illumination



Copyright Keystone View Co

Newly-developed lamp for use in operating rooms where shadowless illumination is essential

Motor Truck Reliable on Suburban Hauls

DURING the last two years, a firm which has been making suburban hauls for a wholesale grocer of Chicago has kept an accurate record of the service rendered by a standard two-ton motor truck The machine was bought in the summer of 1918 and during the six months from July 1, 1919, to January 1, 1920, it piled up a distance of 7,402 miles, having operated 153 days out of a possible 154 This machine is in daily service between Chicago and the towns of South Chicago, Homewood and Hammond, making an average daily run of 48.39 miles with 30 stops, and frequently returning to the wholesale house in time for a short haul in the Loop District of Chicago Formerly all these groceries were shipped by express or freight but the motor truck has proved cheaper and saves an untold amount of time As a result of this service the grocery company has been able to increase its business very materially in the territory mentioned

Fourteen lengths of hose held together by two rods to form a baggage-handling mat

A Shock-Absorber for the Roughly Handled Trunk

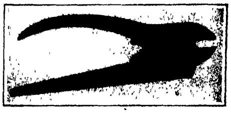
TRY as hard as they may our present-day "baggage smashers" cannot injure a trunk when dropped on the ingenious rubber mat depicted in the accompanying view The mat consists of fourteen pieces of rubber hose held together by two rods The resilient action of the pieces of hose makes it possible to drop a heavy trunk on them from almost any reasonable height without injury to the piece of baggage.

More Land for Food Production

DURING the past three years it is said that 1,239,959 horses and mules have been shipped from the United States to foreign countries, the greater portion of these animals having been used in war service It may be interesting to know that this great exportation of draft animals in no way taxed our supply of available animals, but, due to the increased use of motor trucks, a surplus of some half-million horses and mules is available.

More than 600,000 motor trucks and other commercial automobiles are now in use in the United States and they have displaced approximately 2,000,000 horses and mules Analysis of available records shows that motor vehicles have not only released these animals, but have also released the 10,000,000 acres of land necessary to feed them and made these millions of acres which are so badly needed available for the production of food for mankind.

It is estimated that motor trucks haul 1,800,000 tons of goods annually, at a cost of eighteen cents per ton-mile. With horse-drawn vehicles, the cost of transportation is increased to twenty-four cents per ton-mile.



Pliers-wrench that may be used in place of a monkey wrench in confined places

Pliers That Take the Place of the Monkey Wrench

LOCKING itself on any sized nut simply by continued pressure on the handles, the recently developed pliers-wrench shown in the accompanying illustration is particularly adapted to reaching into almost inaccessible places, where it is not always possible to work a monkey wrench Once the jaws are set upon the nut a continued pressure on the handles locks them in that precise position, but the locking device is immediately released when the pressure on the handles is released. By sliding the catch of the locking device, the pliers-wrench becomes a pair of pliers so that the pressure of the hand keeps a continual -instead of a locked—pressure on whatever is held in the jaws

A Tiny Hoist for All-Round Jobs

THE hauling of material in shipbuilding yards, in the erection of buildings, and in highway grading has hitherto required the setting up of an extensive hoisting system which cannot be readily moved from place to place as the work progresses. To the end of simplifying this phase of construction work of all kinds, there has been introduced of late a simple host of compact dimensions, shown in the accompanying illustration This hoist, or little "tugger," can be mounted in tight places hitherto inaccessible to the usual hoisting equipment It weighs only 285 pounds, and measures 21¼ inches wide, 16½ inches long, and 20⅛ inches high It is operated by compressed air or steam and develops a surprising amount of power.

Using the tiny hoist in building operations to hoist wheelbarrows filled with bricks

Man-Killing Insects

(Continued from page 321)

frequent visits to the skin of the individual in search of his food, the host's blood. The eggs are laid in the fabric of the clothing. These hatch in a few days and the adult state is reached in fifteen days. The eggs may remain dormant on clothing removed from the person as long as forty days As many as ten thousand lice have been found upon a single individual.

The prevention of the spread of typhus fever may be classed under three heads The preventation of lice infestation among the people in general; destruction of the parasites and their eggs found on the person and in his clothing and effects; the prevention of persons who come in contact with typhus fever patients from being infested with lice The cessation of the Serbian epidemic was dependent upon the wholesale washing and delousing of the population Special trains and depots were equipped to carry on this work most expeditiously. It was necessary that all lice on the body and in the clothing of the person be destroyed The clothing was removed in an outer room The body was anointed with a petroleum preparation and then a hot bath was given In the meantime the clothing was being treated by means of live steam in a sterilizing machine so that when the person had completed the bath, his clothing was ready Some delousing plants were of sufficient size to look after fifteen thousand men in one day

The Housefly and His Work

The common housefly is the most filthy of insects From the body of a dead animal, from the manure heap, from the garbage can, from the receptacles of human excreta, the fly will journey directly to the food in the kitchen or on the dining table, lighting on the butter, milk, sugar and other edibles The "fly line" is the shortest distance between filth and food Millions of germs or bacteria have been found attached to the body, wings and feet of this insect, and disease germs have been known to pass through a fly's digestive tract without harm to the bacteria Flies found in the neighborhood of houses containing typhoid fever patients have been discovered to be carrying typhoid bacilli

The fly lays her eggs in some filth pile and in a few days the maggots or larvæ emerge from the hatched eggs After a week or less the maggots enter the pupal or resting stage, and in a few days the adult fly comes forth from the puparium The descendants of a single pair of flies may number over 25 millions in 40 days

Besides typhoid fever, flies may transmit the infection of cholera, dysenteries, infantile diarrhoea, erysipelas, smallpox, yaws, hookworm disease, sleeping sickness, diphtheria and many other diseases

Cholera was and is one of the world's greatest scourges Millions of the earth's inhabitants have fallen before the onslaught of this disease Great outbreaks covering large parts of the surface of the earth have occurred The pandemics usually take their origin from the endemic home of cholera, the region about the mouth of the Ganges River in India From here it spreads possibly to the rest of Asia, or into Africa or Europe, and no less than eight times have its claws fastened upon American soil. The cholera germs have been known to live within the body of the fly for a period of several days.

The Malaria Mosquito

The mosquito is the greatest disease-carrying insect that we have in the United States, and this specifically in its relation to the transmission of malaria. No state in the Union may be said to be free of malaria. In the southern states it is especially prevalent. Being a chronic disease, the reported cases are only a fraction of the actual cases that exist In 1914 it was estimated that there were 138,000 cases of malaria in the state of Arkansas.

So far as scientists are aware, malaria is transmitted in no way except by the mosquito, and only by the anopheline type of mosquito. Although this mosquito was considered as a wild or semi-wild mosquito it very frequently breeds in close proximity to habitations It breeds in rain water barrels, cisterns, and especially in small streams, ponds, swamps and water collections At times it will be found in the most inconspicuous places

The adult female mosquito lays her eggs on the surface of the water; in a day or two the eggs are hatched and the larva or "wiggle tail" makes its appearance After the larval period of seven to fourteen days the pupa or "tumbler" forms In another four or five days the adult mosquito emerges from the pupal case The length of time from egg to adult form varies greatly with the weather conditions

Although the "wiggle tail" and the "tumbler" live in the water, they are air breathers and must necessarily come to the surface of the water to get air This property is made use of in the control of mosquito breeding If the surface of a body of water is sprayed with crude petroleum or kerosene a very thin oily film will form upon the water and when the "wiggle-tail" and "tumbler" come to the top to breathe, their respiratory or breathing tube becomes blocked by the film of oil and suffocation follows Only the female mosquitoes are supposed to bite and suck blood The male of the species usually feeds upon the juices of plants and fruits and is probably harmless so far as disease dissemination is concerned

Anopheline or malaria mosquitoes may be distinguished from other types of mosquitoes by two important characteristics The larva or "wiggle-tail" of the anopheles when at the surface of the water lies parallel to it, whereas the larva of other than malaria mosquitoes hangs at an angle to the surface with the head down into the water Also the adult malaria mosquito when resting on the wall has its body pointing outward at an angle to the surface, while other mosquitoes rest with the bodies parallel to the surface of the resting or supporting plane It may be said in general that the malaria mosquitoes have spotted wings

Malaria is caused by a very minute animal organism getting into the blood of a person This small animal cell really leads a double life, one within the body of man and the other in the mosquito It does not simply pass through the insect but undergoes a definite cycle within the body of the mosquito This development takes about twelve days, therefore a mosquito which has obtained the organisms from a malaria patient cannot carry the disease to other persons until after the lapse of the period In certain diseases as typhoid fever, smallpox, scarlet fever and measles, a great degree of immunity is conferred upon the persons having the diseases, and second attacks of these maladies are rather rare This is not the case with malaria, for a person who once has the disease is more likely to have subsequent attacks

The battle against malaria is twofold a fight against the malarial organisms in man and a campaign against the mosquito. Mosquitoes should not be allowed to attack well persons nor those individuals having malaria Mosquito bars or netting attached to all beds are requisites in malaria communities The proper screening of the houses is necessary The killing of the adult mosquitoes in the house is of prime importance. Although all of these measures are very useful the main point of attack is upon the breeding places of the mosquitoes, that is, all collections of water, however minute,

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc

Pertaining to Aeronautics

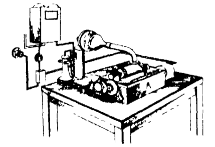
AIRPLANE—W E Osborne, Wagon Mound, New Mexico The invention relates more particularly to airplane wing structure and control The prime object being the provision of a folding wing structure which will permit of housing an airplane in minimum storage space A further object is the provision of a folding structure by means of which the wings may be rigidly held in normal outstanding position or folded against the fuselage so that the machine in disuse may be housed in approximately one third of the space it would occupy with the wings outstanding

Pertaining to Apparel

CHILD'S AND LADY'S GARMENTS—A C Berry, 35 Rowan St, Winfield L I N Y The invention relates to union garments in the form of an outside piece of apparel or a piece of underwear or the like The invention has to deal particularly with the portion of the garment covering the body from the waist down to the knees and embodies a skirt and bloomer legs so designed that a neatly appearing garment is produced with a minimum of material and without bulkiness at the bloomer legs whereby freedom of motion is obtained as well as the proper set of the skirt

Electrical Devices

TELEPHONE ANSWERING INSTRUMENT—W D Calvert, 1420 12th Ave, Altoona Pa This instrument is a mechanical device so arranged with a phonograph or dictaphone that it will answer a telephone when a party calls and the person called is out or so engaged that they cannot immediately answer the phone The object is to provide an instrument which has instrumentalities for raising the telephone receiver and speaking a stereotyped message into the transmitter, both of said actions being automatically initiated upon the ringing of the telephone bell



VIEW SHOWING THE INSTRUMENT APPLIED TO A DESK TELEPHONE

SYSTEM OF ELECTRICAL CONTROL—C E Smith, Box 441, Cle Elum Wash An object of the invention is to provide a device which will automatically connect the main feed wires with the distributing system leading to a mine, whenever power is used in the mine or in connection with mining work and will automatically cut off the general distributing system from the feed wire when the current is no longer in use thereby rendering the wires of the distributing system harmless as far as accident to the workmen or fires caused by short circuits are concerned

Of General Interest

STAKE LOCK—R Dymock, Hamburg, N J An object of the invention is to provide a means for removably locking a stake in a pocket, such means as will be simple and practical in construction and durable in use, and comparatively cheap to manufacture A further object is to provide a stake lock which may be utilized on wagon bodies motor trucks, flat cars and various other vehicles where stake locks are employed

NAIL BUFFER—I Clair, 1035 53rd St, Brooklyn N Y The object of the invention is to provide a construction wherein the buffing part may be readily removed and a new one substituted Another object is to provide a buffer in which the buffing leather or material may be reversed, and a removable padding means whereby the tension of the buffing surface may be varied

ICE CREAM FREEZER—F G Scott, 1501 Seegar St, Dallas, Texas The invention has for its object to provide a freezer wherein the stirring paddle is of the oscillating type and wherein means is provided in connection with the paddle for thoroughly stirring the mixture during the operation of freezing, especially that part adjacent to the walls of the container

ROCKER SWING—J. W Bunt, 2849 Grover St, Denver, Colo An object of the invention is to provide a swing which will maintain a pendulum like momentum for a relatively long period when said movement is initiated and requires but slight exertion to operate the swing A further object is to provide a construction of swing of the lawn type which is strong and durable, yet relatively light in weight

UMBRELLA DRAINING CUP—D R Baity, c/o E K Madel Pat Casey Agency Putnam Bldg, New York, N Y This invention relates to an attachment for umbrellas, and has for an object to provide a structure which may be easily applied and removed and which may act as a drainage cup to permit the passage of water from the umbrella when the umbrella is folded and held in a vertical position

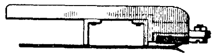
STILL—H P Hird, "Moor End" Dewsbury, England The invention refers more particularly to a still adapted for the manufacture of pitch carbon from coal tar pitch and the like The object is to provide a still which is so constructed that the material can be easily introduced and from which the resulting residue can be readily and quickly removed A further object is to provide a still in which the body consists of a standardized and easily procurable element such as a cast iron pipe elbow

Hardware and Tools

TRAP ANCHOR—W R Lazenby, Box 415, Hardin, Mont An object of the invention is to provide a simple and efficient anchor including separable means which permits of a quick attachment or detachment and which eliminates any accidental separation of the parts when once assembled Another object is to provide a trap anchoring device which is especially designed to permit of the application of the same within a depression whereby the chain secured to the trap may be normally nested in the depression in an out of the way position

LOOM PICKER HEAD—H M Ozment, Box 475, Schoolfield Va The invention relates to loom picker heads of that type which is comprised of laminations of leather It is the purpose of the invention to prolong the life of picker heads of this character by interposing a plate of metal, preferably steel between the laminations in such manner that the entire head as a unit is reinforced against detrimental action of the shuttle

SAW SET DRESSING TOOL—E G S. Clark c/o Genl Deliv, Seattle Wash The invention has for its object to provide a device especially designed to be used after the saw is set and jointed and before filing, to dress down the set in each tooth until all the teeth are in the same plane with each other, thus making a perfect set and to remove the wire edge from the teeth after filing



A SIDE VIEW OF THE TOOL

COMBINATION KEY BARREL CONSTRUCTION—F Clark, 6 Calle de Juarez 82, Durango City, Mexico An object of this invention is to provide a combination key so arranged that a plurality of adjustable ward members may be provided in a minimum space so that they may be readily adjusted to various combinations corresponding to the setting of tumbler members of a lock, without the necessity for the use of movable stops and spring members.

CUTTER—J Vercoutere, 1015 W 4th St Pittsburgh, Kansas An object of the invention is to provide means for securing a cutting blade at any desirable longitudinal adjustment relative to its support so as to regulate the depth of the cut A further object is to provide a cutter which is capable of a wide range of utility in connection with various arts

TRAPPERS' TOOL—W R Lazenby Box 45 Hardin, Mont One of the principal objects of this invention is to provide a hearth boring tool which is constructed and designed as a

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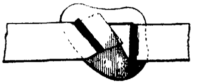
means for preparing the ground to permit of the positioning of a trap and trap [illegible]. Another object is to provide a folding tool, the several parts of which are capable of being nested to occupy a minimum amount of space and which when in folded condition protects the pointed end of the driving shank

BALE TIE BUCKLE—R C. BANKS, Box 133 Dillan, S C The invention relates particularly to buckles which for the purpose of forming the ties are associated with tie bands to secure the ends thereof A further purpose is to provide a buckle which is so constructed and adapted to be related to the engaging ends of a tie band as to permit of its shifting movement on an axis between the tie band end so as to twist itself and one of the tie band ends into firm gripping and non-slipping relation


VIEW SHOWING THE BUCKLE IN THE LOCKED POSITION

TRY SQUARE HANDLE—G E MACONNELL, Jamestown, N Dak This invention has for its object to provide a handle of the character specified wherein the said handle is rabbeted on one face to be flush with the face of the try square for permitting mortises to be marked easily and expeditiously

COMBINATION LOCK—B C PATTERSON, 1111 W 15th St, Oklahoma City, Okla The invention relates to combination locks applicable to carburetors of automobile engines An object is to provide a lock by means of which the needle valve of a carburetor may be locked to prevent gasoline flowing into the carburetor, when desired thereby tending to prevent theft of the car

CLOTHESPIN—G W WALKER, 2207 Seminary Ave, Oakland, Cal The prime object of the invention is to provide a clothespin which includes a double or compound anchor grip for the clothes A further object is to provide a clothespin which will be cheap to produce, easy to manipulate and capable of offering a practical solution of the difficulties experienced with many devices of this kind

ACTUATING DEVICE FOR TEMPER SCREWS—M G GUTHRIE, 506 4th Natl Bank Bldg Wichita, Kan. The invention relates to temper screws used in the drilling of wells and more particularly to a device for actuating the same It is the purpose of the invention to eliminate danger by providing a device which prevents the jerking movement of the pole used for effecting adjustment, in the direction of the operator, while at the same time locking the pole to the temper screw in its forward movement so that the proper adjustment may be effected

Heating and Lighting

HOUSE WATER HEATING ATTACHMENT FOR RANGES—J E and J ZIMMERMAN, 4 Tesla Place, Glendale, L I, N Y Among the objects of this invention is to provide a special water back for a cooking range calculated for use in winter or cold weather for heating water as a basis of a circulating system of house heating. The object is to adapt the cooking range for house heating purposes and yet not interfere with the ordinary functions of the range for cooking or the heating of the water in the adjacent kitchen boiler.

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within a certain radius of the community. The suppression of malaria by means of mosquito control is being more and more recognized throughout the world as the promising way of meeting the malaria problem A number of our own states are now engaged in such campaigns. Arkansas is making great headway in this regard Probably the Panama Canal Zone is one of the best classical examples of malaria suppression by mosquito control.

The Hudson River Bridge

(*Continued from page 324*)

pendous proportions of the later structure

The over-all length of the Hudson River Bridge from anchorage to anchorage will be 6,660 feet, and the length between the main towers of the central river span will be 3,240 feet. At the towers the clear height from mean high water to the under side of the bridge will be 140 feet, and at the center of the channel it will be 155 feet The floor system, which will be a double-deck structure 220 feet in width and 34 feet in depth, will be suspended from four cables arranged in pairs with a horizontal distance between them, center to center, of 165 feet Each pair will hang in the same vertical plane at a vertical distance of 60 feet center to center Due to the fact that the cables will be braced by a system of vertical tension and diagonal compression members, as shown in the elevation, each pair will be secured against deformation, and will serve the function of a stiffening truss The width of each panel of this trussing will be 60 feet, and the floor of the bridge will be supported from each panel point by eye-bar suspender chains In the old Brooklyn Bridge and the other East River suspension bridges the cables consist of steel wires laid parallel and bound up into a cable of circular cross section In the Hudson River Bridge, each cable will consist of 80 eye bars arranged in three banks The diameter of each cable, as thus assembled, will be about 11 feet—in the Brooklyn Bridge the diameter of each cable is 15 inches As a protection against the weather, the cables will be enclosed in watertight bronze tubes, which will measure fifteen feet in exterior diameter This will protect the cables from the weather and will provide sufficient clearance for the workmen to inspect the cables and paint them at the long intervals of many years when repainting becomes necessary Incidentally, the bronze covering will add to the artistic and monumental appearance of the bridge

The main towers, which will be built upon concrete foundations extending to bed rock, will be carried up to a height of 750 feet above mean high water, or practically to the same height as the Woolworth Tower They will be built of steel and covered, from water level throughout their full height, with smooth-dressed, light-gray granite, which will serve as a protection to the steelwork against the weather and will, of course, add greatly to the architectural beauty of the whole bridge. The upper roadway of the bridge will pass through the towers by means of three arched openings, the center one measuring 155 feet in width by 100 feet in height, and the side openings being 30 feet in width In view of the fact that there is a preponderance of sentiment in favor of utilizing the monumental proportions of this bridge in working out a suitable war memorial, it is evident that this three-arched entrance, with its vast spread of granite wall space will lend itself most admirably to the purpose, providing ample space for heroic statuary and commemorative bronzes and tablets

On the landward side the cables will swing down to masonry anchorages on each shore These, like everything connected with the bridge, will be built on a gigantic scale, the pull of the cables necessitating the emplacement of an enormous mass of masonry to provide the necessary frictional resistance. Each anchorage will measure 300 feet in width by 400 feet in length, and that on the Manhattan side will extend about 200 feet above ground level. The traffic will pass through the center of these anchorages, and here again there will be a vast portal, consisting of one central and two smaller flanking arches, which will lend themselves to war memorial decoration.

The floor of the bridge presents some of the most original features of the whole structure The make-up of the floor system consists essentially of a series of great transverse plate girders, or floor beams, spaced 60 feet apart and connected to the cables above by eye-bar suspenders Each floorbeam is actually a plate girder 34 feet deep by 200 feet long, stiffened and connected to the adjoining floorbeams by heavy plate girders or stringers. The upper deck is reserved mainly for vehicular traffic, and the lower deck is given up to trunk line freight and passenger traffic. On the upper deck, between the cables will be provided a broad boulevard 155 feet in width, with a trolley track adjoining the cables on each side. On the outside of each cable will be a rapid transit track and a 15-foot footwalk. The whole of the upper deck will be covered with a steel plate flooring overlaid with concrete The lower floor will be given up to the service of trunk line traffic, both freight and passenger. Originally, it was proposed to provide two moving platforms at the center of the lower floor These, however, will probably give place to standard railroad tracks so that the ultimate capacity of the lower deck will be for ten railroad tracks capable of accommodating the heaviest freight and passenger trains

The surface of the upper deck will be made watertight, so that the whole floor system, in addition to the towers and cables will be protected from the weather. This will result in cutting down the cost of repairing (always a heavy part of the maintenance costs of a bridge) to a minimum. In fact, fifteen per cent only of the steelwork of the Hudson River Bridge will be exposed to the water

The principal stresses to which the bridge will be exposed will be those due to its own dead load. So great is this that, even with the bridge loaded to capacity, the live load would cause a comparatively negligible addition to the dead load stresses The same thing is true of the wind loads The great width of the extremely rigid floor system, coupled with the inertia of the bridge, serves greatly to simplify the problem of providing against wind stresses.

The estimated cost of the bridge itself in round figures is 100 million dollars the freight classification yard in New Jersey, 25 million dollars; the Union passenger station, accommodating the trains of all the roads that come in from the west and north, 30 million dollars; the double-deck elevated railroad down West Street to the Battery, 80 million dollars. The cost of the electrification and equipment of the whole system is set down at 25 million dollars, making a total cost of 210 million dollars for th ewhole scheme.

The yearly traffic across the Hudson River in round figures for the year 1920 was as follows: Passengers, 200 million; draft vehicles, 10 million; freight: coal, 12 million tons, miscellaneous freight, 8 million tons. The present rate of increase indicates that by 1930, or about two years after the bridge is completed, the total traffic across the river will be 250 million passengers, 22 million vehicles and 25 million tons of freight; and it is estimated that of this total, something over one-half will be diverted to the bridge. After the year 1930, it is expected that the traffic across the river via the bridge will grow at an increasing ratio, and particularly the passenger traffic. This expectation is based upon the rapid growth of traffic across the East River with the completion of the bridges and tunnels.

The gross revenue for passengers, vehicles and railroad freight is estimated at 45 million dollars per year during the first year of operation, and in ten years after completion, it is estimated that the revenue will have risen to over 60 million dollars per year. This amount does not include rentals from warehouse and storage buildings which will subsequently be erected

Milk Without Cows

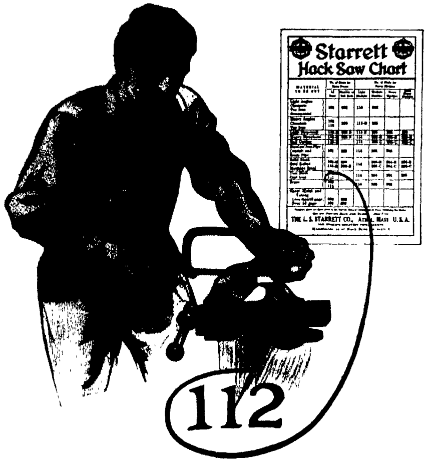
(*Continued from page 325*)

that the bottles coming from the machine could be conveyed by trucks directly into the milk room for storage A galvanized-iron tank used for the washing of cans, which process was committed to hand labor, together with a rinser and steamer, was situated against the south wall of the washing room. A brush washer, for scrubbing extremely dirty containers was located on the north wall of the room.

A two-effect water still, with a capacity of 850 gallons an hour, was stationed on an elevated platform in the southwest corner of the washing compartment. The effluent pipe from this still projected through the wall into the milk room and discharged into a tin-lined distilled-water storage tank of 1,000 gallons capacity. The storage tank, being connected by a tin-covered piping to the suction end of the milk pump, at this juncture permitted the placing of a three-way valve, whereby the liquid could be drawn from either the distilled water tank or the buttermilk machine as desired The discharge from this pump also facilitated the conveyance of the effluent either into a weighing can on a platform near the skimmed-milk vat or to the mixing vats on the balcony A field laboratory, located in the dressing room, determined the bacteriological content of milk and its products as well as the acidity and fat in milk. A 15-ton refrigerating machine preserved the milk as well as the cold-storage department of the commissary The rooms were cooled directly by the expansion of compressed ammonia, the compressor being propelled by a 30-horsepower motor. Brine, cooled by the expansion of ammonia, was employed in cooling the products of the mechanical dairy, the brine being circulated by a steam-driven pump.

The purest of water is essential in the making of reconstructed milk, the Nitro water supply having been previously filtered and chlorinated As with institutions and men—the former being but the shadows of great or small personalities—reconstructed milk in its finished form cannot exceed the quality of the ingredients contained therein The water should be distilled, otherwise, mineral salts may be conducive of harmful results to infants in partaking of the milk The hard waters of the Middle West and those containing an excessive percentage of sulfate illustrate the point.

The skimmed milk powder used at the Nitro manufacturing plant was dissolved by a machine of 800 gallons capacity, the unit being equipped with a revolving heating coil to which blades were attached, serving the functions of agitator and heater at the same time. The vat should be of cylindrical bottom, and should permit of no quarters for undissolved powder. The requisite volume of distilled water is poured into the vat and a weighed ratio of powder added. A sugar scoop can be used in removing the powder from the barrel into the vat. The coil agitator is in operation as the powder is being conveyed to the vat, and the temperature of the water while the powder is being dissolved ranges from 70 to 80 degrees Fahrenheit. Having completed the dissolving process, the skimmed milk is pumped to one of the mixing vats. Here prescribed quantities of butter, already parceled into 4-inch cubes on the porcelain topped table are added and the mixture brought to a temperature of 146 degrees Fahrenheit where it remains con-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One method of testing power blades, which is at least fair to all, is to purchase several blades of each of such makes or brands as it is desired to test, buying one blade of each kind tested from at least three different merchants if possible, in order to get an average run of the product. The blades tested should be of the same length, gage, depth, and "pitch" for each of the different makes, unless one or more of the manufacturers makes some specific recommendations as to the type of blade to use on the material on which the test is to be conducted. Where such recommendations are made they should be scrupulously observed. The blades should all be tested on the same grade of material and in the same power machine, preferably one with gravity feed. The reason for testing all of the saws on the same kind, size and shape of material is obvious. Should the test be made, as is usually the case, on unannealed tool steel, the blades should be alternated, so that should the steel not be uniform no saw will be placed under a handicap by a hard spot.

Observe Manufacturers' Recommendations

One point, however, must not be overlooked Some manufacturers have given the question of Hack Saw efficiency sufficient thought to evolve certain specific recommendations as to the blades, strokes per minute and weight to be used on certain classes of materials and with certain machines. If any of the manufacturers of any of the saws to be tested makes any definite recommendations as to what blade to use under the conditions of the proposed test, they should be rigidly adhered to. Otherwise, ignorance of some of the factors that entered into the manufacture of the blade, and the consequent ignoring of the purposes for which it was intended, will make the test, if not directly misleading, at least of doubtful or little value so far as that particular blade is concerned and will result in conclusions being drawn which are unfair to the maker of the saw. Where definite recommendations as to the use of a saw are not made by its manufacturer, some confusion as to the conditions under which it should be tested may be avoided by identifying it by means of gage and pitch, with a blade whose proper use is known, and testing it according to the instructions for that blade, as given in the Hack Saw Chart on pages 22 and 23 of the book, "Hack Saws and Their Use," published by The L S. Starrett Company, Athol, Mass., for free distribution A copy of the Starrett chart will be sent free upon request.

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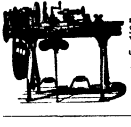

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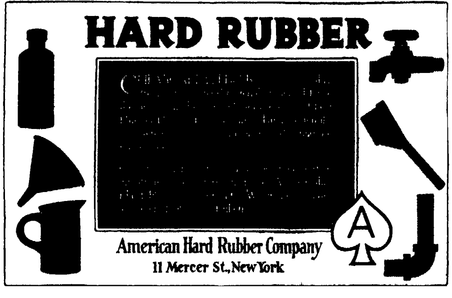

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stant for 30 minutes. Inasmuch as the butter has melted by the time temperature attains 146 degrees, the pasteurization of the skimmed-milk-butter mixture begins when the correct temperature is reached While at the pasteurizing degree of heat, the fluid is conveyed through the centrifugal emulsors Emulsification is the result of forcing the mixture through an extremely narrow opening, the centrifugal force being generated by revolving the bowl of the emulsor at a rate of 15,000 revolutions a minute.

From the emulsors the hot fluid or reconstructed milk is conveyed to the upper trough of the cooler through sections of 1½-inch sanitary milk pipe to which had been attached small conductor heads Foam multiples at this juncture, and to avoid its overflow at the edge of the conductor head and trough, the installation of an antifoam tank between the emulsor and cooler is recommended by the sanitary engineers If the milk leaves the cooler at a temperature of from 40 to 50 degrees Fahrenheit, one of the standard requirements in the process of manufacture has been met Proper regulation of the temperature as the milk departs from the cooler is essential, therefore, the flow of brine should be regulated so that a minimum quantity of milk freezes to the cooler An antifoam tank in the Nitro plant, the device being inserted between the cooler and the can and bottle fillers, eliminates the presence of air space between the cap and the surface of the milk when the bottles are filled directly from the cooler The commonplace procedure of filling the containers with a rotary bottle filler is the succeeding process and having been capped with paper caps, the finished product is conveyed by motor trucks into the cold storage room, subject to a temperature of 33 degrees Fahrenheit, until delivery is authorized

The reconstructed milk as manufactured under war-created difficulties contained 9 per cent milk solids not fat and 3½ per cent butterfat The cream contained 25 per cent butterfat Studies of the bacterial content of the output of the mechanical dairy indicate that it is satisfactory from a health standpoint Ice-cream can be manufactured in quantity production with a bacterial content comparing favorably to that of well-pasteurized milk and cream Conclusions, carefully deduced from seasoned experiments, indicate that children can be nurtured on reconstructed milk as well as on normal cows' milk Adult milk drinkers, used to drinking raw milk, will find the product somewhat distasteful, but those in the habit of partaking of pasteurized milk can switch to the newly-discovered fluid without observing an appreciable difference in flavor.

Stopping Our Coal Leaks

(*Continued from page 325*)

hour service, or 36 million horsepower for an 8-hour working day

It is obvious that we never could completely *accomplish* this, but even if we recover only one-quarter, or even only one-tenth of this waste, it would be a vast increase in our national efficiency.

Here is one way in which this can be accomplished Of the hundred millions tons of coal, which are annually consumed for heating purposes, most is used as steam heat. Suppose we generate the steam at high pressure—as is done now in many cases for reasons of heating economy—and interpose between steam boiler and heating system some simple form of high pressure steam turbine, directly connected to an induction generator and tie the latter into the general electrical power distribution system. Whenever the heating system is in operation, electric power is generated, we may say as a "by-product" of the heating plant, and fed into the electric system.

The power would not be generated continuously, but mainly in winter, and largely during the day and especially the evening That is, the maximum power generation by such fuel power collecting plant essentially coincides with the lighting peak of the central station, thus occurs at the time of the day and the season when power is most valuable. The effect of such fuel power collection on the central station should result in a material improvement of the station-load factor, by cutting off the lighting peaks.

It is interesting to note, that even with a very inefficient steam turbine, the electric generation of such fuel power collecting plant interposed between boiler and heating system, takes place with practically 100 per cent efficiency, because whatever energy is wasted by the inefficiency of the steam turbine plant remains as heat in the steam, and the only loss is the radiation from turbine and generator, and even this in most cases is useful in heating the place where the plant is located. The only advantage of a highly efficient turbine is that larger amounts of electric power can be recovered from the fuel, and the question thus is that between the investment in the plant and the value of the recovered power.

The Sailing Ship's Return

(*Continued from page 326*)

of free power in a way which it lies within our ability to do?

The art of sailing-ship design reached its pinnacle in the fifties of the last century Many a brave clipper-ship in those days raced westward around Cape Horn, or out to the China Sea, making for days on end a sustained speed of from 13 to 15 knots—a speed which would leave the average freighter of today very far astern, and the thing can be done again Only today the ships must be larger and they must carry smaller—far smaller—crews

However, both of these conditions can be fulfilled: the use of steel and our better knowledge of the strength of materials make the first possible, and our wonderful assortment of labor-saving devices permits the second. It is merely a case of experiment and adaptation

With this in mind, Mr Liljegren has developed the scheme for a most interesting type of ship To an American she looks not unfamiliar, for she is essentially a big five-masted schooner, resembling closely the large coasting craft that are so common a sight to all who visit our Atlantic shores during any summer season

This particular ship is, however, to have some interesting modifications of design, both in hull and in rig The one which first strikes the eye is the division of the big fore-and aft sails into an upper and a lower half for greater ease in handling Furthermore, the actual handling of sail will be done to a very large degree by machinery, thus reducing the crew to the minimum number A steam or motor winch is employed in our present big schooners for hoisting the sails, but Mr. Liljegren proposes to go a long step farther and install a "unit system" of electric motor winches—a separate drum winch *to* each halliard and sheet *on* the vessel These motors may be controlled from the quarterdeck by the mere throwing of a switch; so that, for all ordinary operations save reefing, the officer on watch and one hand, at the wheel, will actually be all the persons needed to handle the ship

Power for these labor-saving devices is to be supplied by a Diesel engine driving a generator This engine will also serve to propel the vessel at a moderate speed in calms, thus overcoming the one great drawback of the sailing ship, that of time loss on routes where belts of prevailing calm and light airs have to be traversed. Besides these two principal uses the vessel's power plant will run the cargo hoists, and supply light.

Structurally it is interesting to note that the designer proposes providing this ship of the future with a pair of weighted centerboards, one forward and one aft, to improve her sailing powers by reducing leeway and also to increase her stability when "flying light." Here he has ob-

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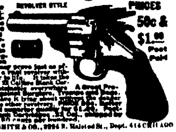

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viously taken a leaf out of the yachtsman's book, for no merchant vessel of more than 500 tons' register has ever been built with anything resembling a centerboard

This is all most interesting, the new departures and "gadgets" not least of all, but one who has had practical sea experience in modern sailing vessels cannot help wondering if Mr Liljegren knows that a smart Yankee five-master of the present day can show her heels in a breeze quite easily to the average tramp steamer and that she can, even today, make money at rates under which the tramp is unable so much as to pay for her coal

No doubt some further refinement in design and the addition of practical labor-saving devices such as wire running gear and drum winches would make her still more economical Perhaps, then, the solution of the ocean freighting problem is even nearer than we realize Possibly in another five years we shall see the lofty topmasts of the ships from Bath and Boothbay crowding the harbors where almost a century before the Yankee clipper was proclaimed queen of the Seven Seas

Cinematography at the Winning-Post

(Continued from page 327)

justing the width of the shutter slots, be taken out of the case

After thus getting the five fold camera into order, it is inserted into the case fixed by means of the bracket to the judge's stand This comprises an additional objective shutter, the variable position of which is indicated by two red discs and one rectangular yellow plate and which is intended to prevent the production of a veil on the highly sensitive photographic plates

The apparatus should be so inclined as to point the central objective toward the central part of the race course, after which the *adapter with the plates* inserted is introduced into the camera In order to protect the plates as long as possible against any false light, the adapter slide should not be drawn out until the horses have been taken to the race course

The apparatus is started electrically by means of a switch from a point situated about 3 meters away from the winning post As the horses are appearing at about 50 meters before the winning post, the switch-lever is operated, thus opening the additional shutter by means of the current coming from an accumulator battery The yellow plate now disappears, whereas the red disc becomes visible, the lever should be at once returned into its position of rest

When the horses have arrived at the auxiliary winning post line, 3 meters in front of the actual winning post, a short pressure on the key fixed at the right side of the switch will open successively the five objective shutters

This method is based on the fact, brought out by experience, that there is for the observer entrusted with the opening of the objective shutters, one especially advantageous spot where the time error no longer matters When the observer is posted quite close to the winning post he will appreciate only inaccurately the moment when the horse's nose is passing through the plane of the latter. As his distance increases the accuracy of his appreciation will first increase and eventually decrease again In the interval there is some "optimum" point where the individual error of appreciation is least, but which, of course, varies somewhat from one person to the other

Inasmuch as the few plates required for the process can be developed in the judge's stand, and as any photographically skilled observer, even before the developing of the plates is completed, will discern all essential data, the judge's verdict can be given out by the time the horses are returning to the scales, and as a special

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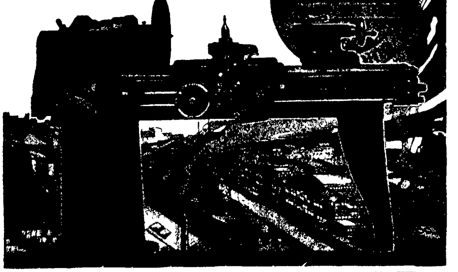

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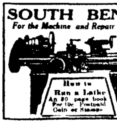

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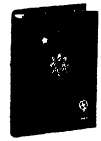

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Hydroelectric Power in Argentina

(Continued on page 330)

What the government will do with this scheme remains to be seen; but private electrical engineers in Buenos Aires are not so confident of its success as are Government officials Critics of the project do not dispute the figures given in the report for the simple reason that no independent investigation has been made but they do question the soundness of the conclusions arrived at on the technical side To transmit power 750 miles to Buenos Aires, which must be the manufacturing center of the republic, is not regarded as practicable If it can be done then it will be the biggest undertaking of its kind that has yet been attempted The economic aspect of the scheme is viewed with grave doubt As an electrical engineer pointed out to the author the Iguazu proposal differs vastly from that centering round Niagara There the transmission of current does not mean anything like a distance of 750 miles The power of Niagara is utilized by dozens of cities and towns comparatively close to the generating center and there is no dearth of customers Between the Iguazu Falls and Buenos Aires there are only two or three large cities which are likely to develop into manufacturing centers and not one of them is less than about 500 miles from the falls The idea that the inland railroads will electrify their systems and so become customers is scouted In and around Buenos Aires electrification has gone on, but the day when anything more than the urban and suburban traffic lines will be worked electrically is considered to be too far ahead to admit of useful discussion just now in connection with the Iguazu scheme

"I will tell you what there is to this scheme," said one engineer "In the first place it is an international problem in one sense The falls divide Argentine and Brazilian territory Before anything can be done the two countries which have equal rights to the water must agree, and if Brazil has the same ambitious notions as Argentine she is going to demand half the power That means that Buenos Aires or other centers can only get half the energy, so that instead of 125,000 kilowatts there will be 62,500 If that could be transmitted 750 miles, which I do not believe is at present possible, the unit of energy to the city would be proportionately more costly

"The engineering side of the scheme, outside of the transmission problem, only presents one difficulty, and that is in the variation of the head of the water due to the rise and fall of the river, there being a difference of as much as 100 feet in the head Otherwise there is no great problem, though the job will be very costly The river can be dammed, according to the Government engineers, and a canal will then have to be cut some kilometers through Brazilian territory, to convey the water to the power station which would be located below the falls.

"I estimate roughly that electrical plant and material worth $30,000,000 gold will have to be imported, if the scheme ever goes through, and I suppose this will be bought in the United States. I don't know that any private company will be given the chance to take up the scheme, it being generally accepted that it must be a State undertaking, but if the chance were given I can't imagine any private engineering concern tackling a job which does not look to me like giving practical results in this or the next generation The Government need not look on the undertaking in this way First it can raise the money it wants cheaper than a company could, and second it does not necessarily require direct and immediate financial results Governments look for broad indirect benefits from such schemes, and don't mind losing a few millions in the early stages of operation Even so I consider the Iguazu proposition is one that will not be realized in our time"

That, of course, is a private opinion, and it does not coincide with the Argentine idea of what is practicable and what is not Some day the generating of electrical energy at the great falls, and its transmission to Buenos Aires will be a practical scheme, if it be not so today And the Argentine in his enthusiasm will never object if the anticipation of that day by ten, or a hundred years, costs his country a few millions of dollars. He would willingly face the loss if it meant a solution of his fuel problem.

A Hospital for Mail Bags

(Continued from page 332)

offices Consequently, renovation is the first task of the salvage department in rescuing the sacks to useful service Two tumbling barrels have been set up by the mail equipment shops for this specific purpose They are built in the form of a star which revolves, the bags tumbling from one point of the star to another. The dust is beaten out through slats, of which the barrel is constructed. The space on the outside of the tumbling barrel is boxed in the form of a closed room with a large pipe running therefrom to a canvas bag located outside of the building A powerful suction fan has been installed in the pipe and by its operation the dust is drawn from the boxed-in room to the canvas bag referred to above

Sacks consigned to the mail equipment shops, subject to salvaging, are first inspected and assorted according to the following classifications Serviceable, condemned, machine repairs, stringers, and patches Their respective needs are thus identified. Bags subject to patching are further inspected by patch-fitters who salvage a good head from one ill-handled unit and a sound bottom from another "bum," and thereby refashion a standard size sack Machine operators sew the units together into a compact container Some 200,000 remodeled bags are thus salvaged to the postal service annually, which otherwise would represent a loss. The life of the made-over container is about two years, many of them capable of rendering service equal to that of new ones

Repairs, insofar as practicable, are made by sewing machines The work as it leaves the machine is assorted into finished and unfinished piles, the former being immediately packed for shipment and the latter redistributed to hand darners who sew up any holes around the metal eyelets which machine operation was incapable of doing Bags classified as "stringers" are distributed to workers whom the designation implies, who renew lacing cord, etc Condemned bags, pronounced altogether unserviceable, are mutilated into scraps and marketed as "junk" under contract to the highest competitive bidder

Labor is employed to divorce the metal parts from the leather and canvas, experience having justified as a profitable method the sale of the same separately rather than as unclassified waste. Including the cost of labor, material, expense of stringing, etc, it is computed that sacks are salvaged for less than eight cents apiece, with an estimated saving of $443,077 81 for the past fiscal year to the Government.

Fossil Footprints of Texas

(Continued from page 333)

other parts of the body showing the texture of the skin. Later, parts of skeletons were found in the rocks thus giving the first positive confirmation of the presence there of dinosaurian reptiles.

Other attendant phenomena have left their records such as the rain drops of a summer shower, ripple and beach marks These are sometimes preserved with wonderful fidelity and minuteness of detail In the National Museum at Washington is a slab of these Connecticut Valley footprints showing tracks of two three-toed reptiles crossing it, one made before, and one after such a shower, as shown by the presence of rain drop impressions on the one and their absence on the other Of course, all of these imprints were made when the sediments were yet soft mud and before they were consolidated into hard rock as we see them today. That some people do not understand this is indicated by the conversation of two countrymen standing before a large slab of footprints in the National Museum. One of the men, after hastily reading the label, was overheard to remark to his companion, "That must have been a durned heavy critter to push his feet down into the rock like that."

The amount of information to be gained by a study of a slab of these foot impressions is interestingly told by Prof. R. S Lull He says: "One extremely interesting specimen in the Amherst College collection bears in all about fifty impressions (sketch reproduced herewith), most of them made either by the same animal walking back and forth along the beach or by several of approximately the same size. In one of his journeys the creature slows down as shown by the fact that the tail begins to drag, whereas it has been held out stiffly behind to counterbalance the weight of the body Then the animal stops and comes down on all fours impressing the little hands and long heels, then having satisfied his purpose, it rises again to its hind feet, touching one hand and the tail tip once more to the ground regaining its balance and then goes on its way The single slab gives us thus a knowledge of the creature's size, proportions, gait, resting posture, feeding habits for the little hand with its nail-like claws could never have been used for grasping prey, and finally, the texture of the skin on the soles of the feet with creases between the joints, like those of the human fingers, and tiny granulations like mustard seed covering the entire surface"

Geologists picture this region at the time these tracks were made as a tidal estuary In places in this estuary were flats, some well out in the ancient bay, others nearer shore, which were left bare by the receding tides Here the animals congregated, possibly they came for food The impressions made when the tide ebbed were baked by the tropical sun and thus somewhat hardened before the incoming flood bearing its burden of sediment gently buried the traces without injury, thus preserving for our enlightenment these evidences of past animal life.

It is some modification of the conditions pictured above that will account for the preservation of the Texas footprints. However, before much can be said of the reason for their preservation or the kind of an animal that made them they must be the object of special and detailed study, and it is hoped that the owner of the land will soon make them available to some scientific institution where they may be given the critical study necessary to properly interpret them, and also where they may be exhibited to those who may be interested in such evidences of the past animal life of this continent.

New Remedy for Healing Wounds

THE *Danish Weekly for Physicians* informs us that Dr. Fischer of Kopenhagen has succeeded in producing a liquid medium which is said to be exceedingly efficient in surgery. The new remedy, which its discoverer calls "Incotamin," consists of a pancreatic extract and a serum; the nature of this latter has not been definitely stated. The remedy has been most effective with wounds which showed a tendency to delay in healing. It has failed, however, with cancer, tuberculosis and syphilis wounds.

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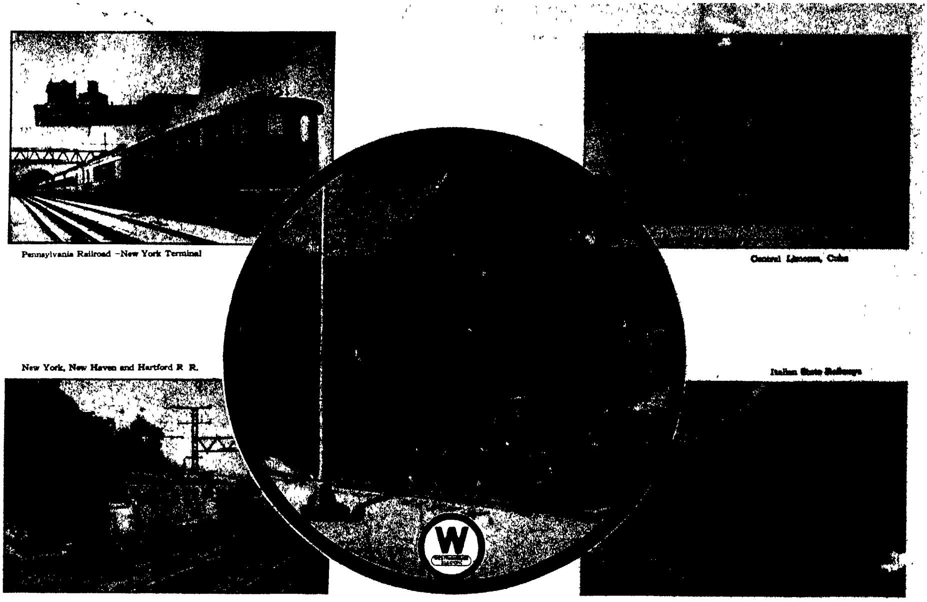

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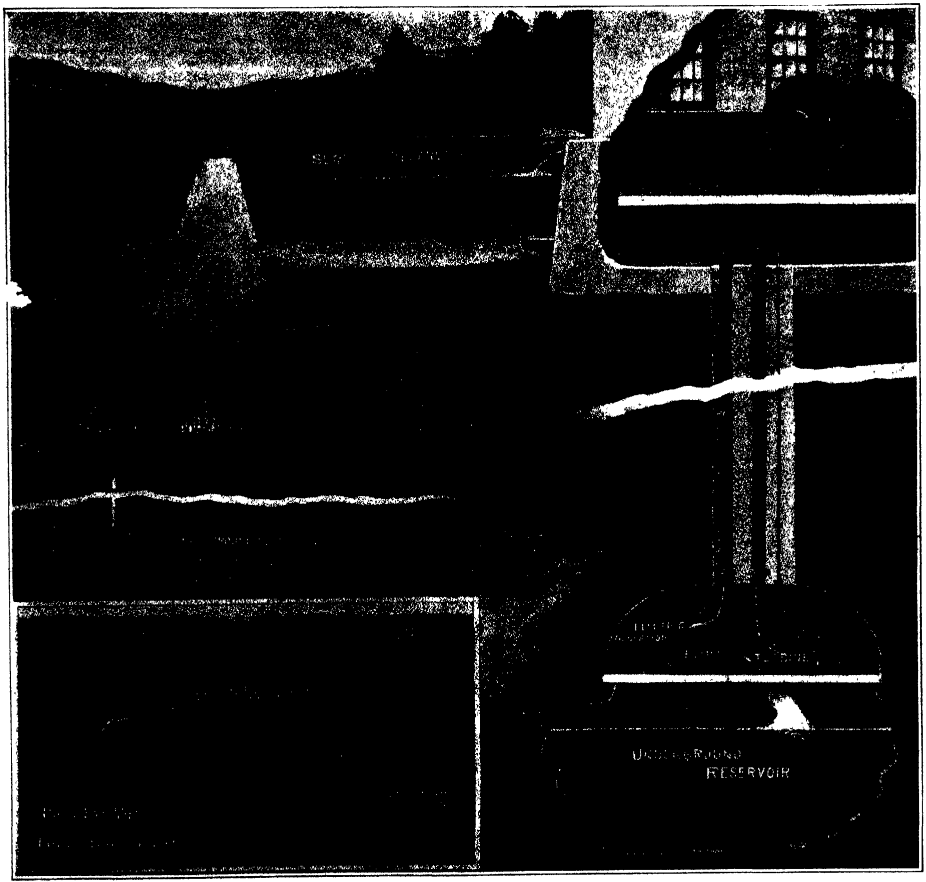

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Phantom Ships

THE propaganda for driving the United States into the construction of a navy larger and more costly than the present world conditions demand has resorted to many half-statements and positive misstatements which cannot be too quickly nailed down and refuted Prominent among these has been the announcement that Great Britain is building for Japan several huge warships greater than anything yet designed The inference, which the sponsors for this untruth were hoping that Congress would draw, was the obvious one that England's good faith in stopping warship construction and cutting down her navy was questionable, since the building of many big warships for her ally, Japan, was tantamount, in the event of hostilities, to building them for herself

The most interesting fact about this statement is that it is absolutely untrue Great Britain has no military alliance with Japan, so far as this country is concerned, the United States having been expressly exempted as a possible enemy, and furthermore, Great Britain is not building a single capital ship either for herself or any other power This we have ascertained through our London correspondent whom we asked to make a thorough investigation He writes us that no capital ship of any kind is at present building or completing in the United Kingdom, either to British or foreign order, nor has the keel of a warship of any description been laid to foreign order since the armistice He tells us that, after spending some time in investigating these rumors, he found that the only grain of truth lay in the fact that the following contracts have been placed by the Japanese Government, namely an order for some special curved armor for ships and for some sets of Diesel engines for submarines from Vickers, Limited, and an order for armor-piercing shell from Hadfields, Limited This, he informs us, is the sum total of work being executed in the United Kingdom on behalf of the Japanese navy

In an interview with Captain S Kobayashi, the Japanese Naval Attaché in London, he learned that there was practically no possibility of warship orders being placed abroad, owing to the fact that the Japanese shipyards were very short of work and were therefore most anxious to secure any orders which might be available Hence, the Attaché thought that the Japanese Government would not contemplate placing orders for warships in a foreign country

Referring to certain criticisms which have been made in regard to the departure of British airmen for Japan, our correspondent informs us that these men are going, not as a part of a special mission, but simply as private individuals. They are nearly all ex-officers of the Royal Air Service, whom demobilization has left without a job, and they are naturally eager to accept employment in the flying line wherever it can be found

So much for this mare's nest, which is typical of much of the altogether vicious and designedly misleading propaganda which is being prosecuted, not in the interest of peace, but in the endeavor to stir up suspicion between great peoples, whom the stress of the great war has brought into relations of mutual confidence and respect

Measuring Impact Effects on Roads

THE need for strengthening county bridges to withstand the impact of heavy vehicles was recently discussed in these columns The importance of the question is equaled only by the neglect with which it has been treated Only of late years, indeed has the magnitude of impact stresses begun to be appreciated both by the road and bridge builder, and hence the report on this subject by the United States Bureau of Public Roads, which has just been made public, is very timely The report deals with a series of experiments which has been carried on at Arlington, near Washington, D C, for the past two years Although the complete deductions to be drawn from the tests have not been made, sufficient data have been developed to show that the magnitude of the impact of wheels upon the road surface is very closely related to the tire equipment

Of course, any analytical mind that gave even a passing thought to the question realized that there was a wide difference between the static pressure upon a roadway of the wheels of a motor truck when it was standing still and the impact effect, in the form of a succession of blows, when the same wheels were passing swiftly over a road of uneven surface It will surprise many drivers of motor trucks to learn that if the solid-rubber-tired rear wheel of a motor truck which is traveling at 16 miles an hour encounters an obstacle that stands only one inch above the roadway, it will strike a blow whose vertical effect will be seven times the load on that wheel On the other hand, if pneumatic tires be used, the average impact is only from 1¼ to 1¾ times the wheel load The moral of these results, as far as the truck is concerned, is to show the value of the pneumatic tire in reducing wracking effects on the machine itself So far as the roadway is concerned, the tests, as thus far developed, preach the lesson of eternal vigilance in making quick repairs of any depression or breaks in the roadway, for it is obvious that as the depth of a hole is increased by the traffic, the impact effect will grow in proportion. Well might President Harding, in his address to Congress, deplore the fact that millions of dollars are expended in building good roads, and quickly lost again by neglecting to maintain these roads in good condition

Train Speeds and Track Costs

APROPOS of the question of impact effects of motor truck wheels on highways, we note that the American Railway Engineering Association has issued a report on the effect of increased speed in raising the cost of track maintenance, in which the fact is brought out that there is an increase in the cost of maintaining the track of 0 5 per cent for each increase of a mile per hour in the speed of freight trains

No doubt, it is popularly supposed that because the steel rails of a well-laid track present such a smooth, even surface to the eye, impact effects due to irregularities of surface are unknown As a matter of fact, the average railroad track is not as perfectly true in surface as it would appear to be, and because of the varying degree of elasticity in the ties and roadbed, there are frequent relatively hard spots, which have the effect of inducing heavy vertical impacts from the concentrated wheel loads of the train Furthermore, there are the lateral impacts, due to the nosing of the engine and cars and to the surging of the train on passing around curves that are not of perfectly even curvature

In a general way it may be said that impact effects will vary as the square of the velocity, and hence will produce a proportional increase in the wear of the track and the cost of the labor, tools and materials necessary to keep the track up to a given standard An analysis as given in the *Engineering News-Record*, supposes an increase in the average speed of freight trains from 20 to 25 miles per hour over a road of 75 per cent tangent and 25 per cent curves The increase in maintenance expenses in such a case works out at about 2 4 per cent, which for freight service gives a rate of 0 5 per cent per mile per hour increase

Progress in Our Army Ordnance

THE lessons of the Great War have been turned to good account by our Army Ordnance. The country will be glad to know that its ordnance experts have sifted out and translated into improved ordnance the lessons of war, and that they are producing new weapons which are superior—greatly superior—even to the fine weapons with which the war was fought Take for instance the famous French 155 mm mobile gun, which formed, with the 75 mm., the principal artillery of our American army at the front This is a justly famous weapon, designed by the French, which contributed greatly to the success of the Allies. The gun, which is of practically six inches caliber, has the wide angle of traverse of 60 degrees, and a maximum elevation of 35 degrees. At this elevation, with a muzzle velocity of 2,380 feet per second, the shell was thrown to an extreme range of 17,700 yards. The gun has a length of 38 calibers. Army Ordnance has produced, since the war, an improved 155 mm. gun and carriage. The gun has been increased in length from 38 to 45 calibers, the muzzle velocity has gone up from 2,380 to 2,800 feet per second, and the carriage has been so designed as to admit of a maximum elevation of 65 degrees. At this elevation and velocity the maximum range is 26,000 yards, or about five miles greater than that of the French model of 1918. An 8-inch howitzer carriage has also been designed, which at 65 degrees elevation gives a maximum range of 18,000 yards It is gratifying to note that with the exception of the gun, whose weight has been increased from 8,800 to 9,200 pounds, there is a decrease in the weight of the new weapon, the weight of material in firing position having been reduced from 25,900 pounds to 24,000 pounds and the weight of the gun carriage and limber, complete, from 29,400 pounds to 28,000 pounds, while the weight of the maximum load when traveling has been reduced from 25,400 pounds to 17,000 pounds Army Ordnance is to be congratulated upon these excellent results.

In Justice to the Army Air Service

THE American people have no wish to be unjust, and therefore they will welcome any opportunity to correct an unjust charge. Frequently during the war, and since, we have heard the statement that the Government spent over a billion dollars for aircraft and "had nothing to show for it." Now, we have no intention to stand as apologists for the many and serious mistakes which were made in our wartime aircraft effort These mistakes are frankly acknowledged by the authorities themselves; but the statement that we spent a billion dollars for nothing is doubly untrue, first, because the actual expenditure during the war in our aeronautical endeavor was exactly $598,090,781 ; and secondly, because for that money we secured nearly 20,000 machines, trained a great army of fliers, and placed a large force both of machines and men in the war zone before the signing of the armistice.

These facts have been compiled by the *Aviation and Aircraft Journal* from the official report of the Liquidation Division of the United States Air Service, and are published in the issue of April 18th. The Liquidation Report shows that the actual amounts appropriated for the Army Air Service during the war aggregated $1,687,054,758. From this total amount, there were revoked by Congress sums aggregating $487,000,000, so that the net amount available for expenditure by the War Department was $1,200,054,758. It is now revealed that out of the amount available for expenditure, no less a sum than $582,564,781 has been returned to the United States Treasury. So much for the "wasted billion dollars"

Now, as to the actual production and work accomplished. In round numbers the amount spent for army airplanes in the United States was 114 million dollars, for which the Government received 13,894 American-built airplanes. The Government spent abroad the sum of 189 million dollars for training and for the purchase of airplanes, engines, construction of cantonments and production centers, and received, among other equipment, 5,198 complete airplanes, making a total of 19,092 airplanes produced in the United States in a period of 21 months, which exceeds the production of any other country for a like period At the signing of the armistice, in addition to the 5,198 airplanes purchased abroad, 2,091 American-built seaplanes had been shipped to France, and 1,040 were either at points of embarkation or were in transit. Of these, 1,444 had been actually received in France, of which 667 American-made machines were in service at the front.

Let us be fair. We started the war with nothing. We had to create three times; an airplane industry, a fleet of airplanes, and a force of trained pilots. At the armistice we had a huge well-organised industry; nearly 20,000 airplanes; and a whole army of carefully selected and thoroughly trained fliers. The novelty and magnitude of the task and the speed with which it was accomplished render the total cost of 590 million dollars not unreasonable.

Engineering

A Long Aerial Tramway.—Contract for an aerial tramway from the Premier mine in British Columbia to tidewater has been awarded to a Spokane company. The line will be nearly twelve miles long, with a drop of about 120 feet to the mile. The tram line, bunkers, and unloading devices will cost a quarter of a million dollars.

Ocean Sewage Disposal.—The State Department of Health of New Jersey has been conducting a serious investigation to determine the effect that the discharge of sewage into the ocean has upon the quality of water at bathing beaches. The results indicate that effluent travels approximately parallel to the shore, and in a very narrow stream; that the ocean water rapidly dilutes or oxidises the effluent; that the surface film of effluent ultimately reaches the surf but only after such great dilution that it is of a higher bacterial standard than surf water where there are numerous bathers

Concreting a Railroad Tunnel.—The Canadian Pacific Railway is concreting the five-mile Connaught Tunnel near Glacier, British Columbia This tunnel is through solid rock and although this material would be supposed to be of the most lasting character, a lining of concrete is being placed against the rock to make assurance doubly sure for a clear and safe roadway for the trains. This difficult work is being done without interference to the operation of traffic The smoke from the trains is blown out of the tunnel by giant fans set in motion after a train passes, and it only takes a few moments to clear the air the entire length of the tunnel.

Facing Buildings with Pottery.—In a recent lecture before an English gathering Prof Beresford Pite discussed the possibilities of ceramic products in the clothing of reinforced concrete skeleton buildings Unlike many architects who regard traditional practice as something quite sacred, Professor Pite would throw the conventions of the past to the winds in order to meet modern developments While admitting the structural advantages of reinforced concrete, he is not an admirer of concrete as a material for exterior surfaces, and advocates the clothing of the structural skeleton with "a garment of permanent, effective, beautiful, ceramic color, unlimited in its variety and worth."

Road Construction in China.—The Central Government of China is evincing considerable interest in road building, and the Ministry of the Interior, which has charge of highway projects in conjunction with provincial officials, is said to have prepared a bill concerning highway development for presentation to the new Parliament, which is expected to meet in Peking at an early date. Considerable road construction is being conducted in connection with the famine relief work whereby the recipients of relief are enabled to render compensation for the food furnished them and thus contribute to the permanent betterment of China's transportation facilities, which will tend to minimise such catastrophes in the future

A Mold for Measuring Rail Wear.—The old-fashioned method of ascertaining the extent to which a rail has been worn under traffic by taking it out of the road and weighing it, is now superseded by taking a mold of the rail and calculating the weight from a tracing of the cast The first material used for this purpose was plaster of paris, but this was found to be unsatisfactory owing to its irregular contraction. A British engineer has now introduced the use of plasticine, according to *Engineer*, for the making of the mold, and has patented a simple form of nut-cracker apparatus for rapidly taking rail molds in plasticine The mold is placed with a piece of sensitised paper behind it in a printing frame and the area of the photograph produced is taken out with a planimeter, and the weight of the rail calculated.

Pre-cast Concrete Roads.—Owing to the impossibility of finding suitable aggregates, or even the provision of the necessary water for concrete-making, along the route taken by a new high road under construction from Casper to Salt Creek, Wyoming, it has been necessary to establish a casting plant at Casper, where these are available, and to transport the finished slabs a considerable distance before laying, says the *Technical Review*. About six miles have already been covered with slabs 16 feet wide and of an average thickness of 6½ inches; and if the scheme proves generally successful, a further 40 miles will be laid to form a roadway of a present width of 9 feet. The slabs are of reinforced concrete, the purpose of the reinforcement being merely to strengthen the slab for the purpose of lifting and hauling to site. The finished slabs weigh 6,300 lbs. each and are cured for 30 days under proper conditions.

Science

Dolphin Steak a la Russe.—The use of the flesh of dolphins for human food has proved successful. A Moscow despatch reports that steps are being taken to establish a dolphin fishing industry.

Helium for Divers.—The suggestion is put forward by the *Chemical Trades Journal* that if a mixture of helium and oxygen were supplied to divers it might considerably lengthen the time they could remain under water, on account of the increased rate of expulsion of carbon dioxide from the lungs which would be produced.

A Huge Emerald.—An uncut emerald weighing 630 carats has recently been brought to this country for dividing and cutting, as of course it would not be marketable in its present form There are larger emeralds in existence; one in Bogota weighs 1,000 carats, and one of the Russian crown jewels, before their dispersion, weighed 6¾ pounds

The Zoo and the Aquarium Top the List.—The New York Zoological Park, referred to by the vulgar as the "Bronx Zoo" very much to the Director's ire, had 2,150,177 visitors during 1920 and the more conveniently situated Aquarium at the Battery had 1,994,548 visitors This is the largest popular following of any organization in the world for the New York Zoological Society operates both enterprises.

Raising the "Yak" in Alaska.—The "yak", or woolly ox of Thibet, is soon to be transplanted into Alaska and the Canadian northwest by Dawson men For centuries the yak has been domesticated by man and its haunts are the snowy highlands of Thibet, 20,000 feet above the sea Its native food is coarse wiry grass, but it will eat anything that cattle will In size it compares favorably with range cattle—1,000 to 1,200 pounds The meat is as delicious as beef, and the wool and hide are valuable.

Reindeer Meat for All.—Reindeer meat is one of the solutions of the ever-present beef, lamb, mutton and pork problem. Reindeer are multiplying much faster than the needs of Alaska require A company has established a plant at Nome for handling twelve thousand carcasses a year. The meat can be sold profitably even though the freight rate is $140 a ton to Minneapolis The dressed carcass weighs about 150 pounds, but this could be increased to 300 pounds by crossbreeding with the caribou, a heavier animal

Bulgarian Surgeons Adopt Stone Age Methods.—Stone Age tools are being used in Bulgarian hospitals to perform surgical operations In the absence of any steel instruments whatever with which to operate, the Russian surgeons in charge have taken a leaf from the book of their prehistoric ancestors, and have used chipped flints Moreover a freshly chipped flint has an excellent cutting edge and possesses perfect immunity from infection. So crude but thoroughly septic operations are being performed with flint knives.

Summer Furs Exterminating Animal Life.—Prof Osborn has made a plea for women to cease wearing so-called "summer furs." He said wild animals are being destroyed so rapidly that in thirty years there will be practically none left and the next generation will have to go to a zoological park or look at paintings or photographs for a knowledge of wild animals. Professor Osborn is an exceedingly careful writer and speaker and his warning is amply justified, the senseless wearing of furs in summer should be abandoned

Trying to Save the Elk.—The elk are in danger of extermination, 10,000 head supposed to be in the Yellowstone having disappeared. This seems to be caused by cattle men grazing their herds on areas formerly occupied by the elk, which perish in great numbers when they find their old pastures denuded Ranchmen in many cases have fed them hay out of pity and the Federal authorities have bought and stored hay in the hope of preserving the breed. Cattle men are not much interested by these splendid examples of animal life so that the Government should do something on a large scale to preserve them.

Alloy Research.—The National Research Council announces that an Alloys Research Association has been formed, the primary object of which is to furnish "An informational service concerned with metals and their alloys." It proposes to supply, to those applying for it, information as to current literature, discoveries, etc., and references and abstracts of all known information upon a given subject This is of interest to mineralogists and crystallographers because many of the properties of metals are related to their crystal structure (although this is not mentioned in a list of over 40 properties and phenomena which the Association has tabulated as important).

Electricity

National Electrical Safety Code.—Handbook No. 3 of the Bureau of Standards has recently been published and may be obtained from the Superintendent of Documents, price 40 cents This new edition is a book of pocket size and the discussion of the rules has been segregated in a separate volume, which will appear later as Handbook No 4

Telephoning 5,700 Miles.—Another technical triumph for the engineers of the American Telephone and Telegraph Company was scored on April 11th last, when President Harding of the United States and President Menocal of Cuba formally opened telephonic communication between Cuba and Washington, and immediately afterward messages were sent from the Catalina Islands, off the coast of California, to the Cuban President at Havana, a distance of 5,700 miles The radio telephone, land lines and cables were used to span the intervening distance

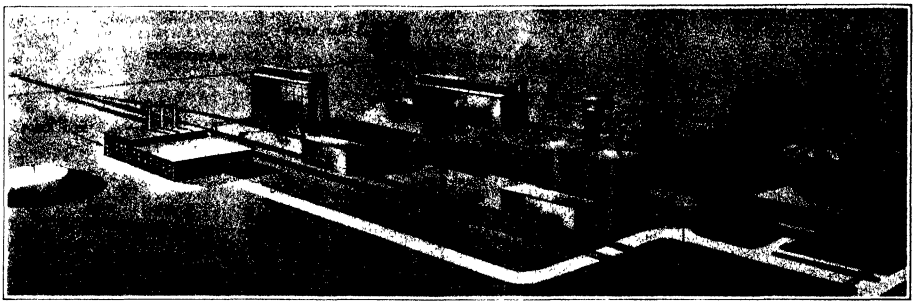
Fused Silica Valves for Radio.—From the English *Electrician* we learn that considerable progress is being made in the construction of "valves" for handling large outputs by H M Signal School at Portsmouth Patents have been taken out by the Admiralty for the construction of vacuum tubes in fused silica which has made possible the handling of larger outputs It is believed that considerable ranges have already been effected with silica valves, and that there seems no doubt that if the present progress is maintained the silica valve may ultimately supply the best solution to high power stations

A Telephone Receiver of the high resistance type may be used for testing high voltage insulators while the line is in service, according to an authority writing in *Electrical Review* This test is used mainly on lines using pin-type insulators, as it is of less value with suspension-type insulators One terminal of the telephone circuit is mounted on an exploring rod and may be brought near to, or actually in contact with, the transmission line pole at a considerable height above the ground The other terminal is grounded If there are leakage alternating currents of appreciable magnitude flowing in the pole a peculiar crackling noise is heard in the telephone receiver, but if all the insulators are in good condition nothing but a musical hum will be heard

Improved Beads for Insulation.—In certain installations, such as radio equipment, arc lamp wiring, and laboratory apparatus, it is often necessary to resort to beads for insulating bare wires Heretofore the beads have been of a plain design, with rounded ends, resulting in a rigid covering which prevented the covered wire from being bent as desired, or left bared sections of the wire between the beads because fewer beads had to be strung in order to allow for bending An English concern has recently introduced a new type of bead which is rounded at one end and hollowed out at the other, thus permitting of one bead fitting into the hollow of the next bead These beads permit of covering a wire for its full length, yet do not interfere with the bending of said wire

Testing Porcelain Insulators for Cracking.—Electrical puncture may be what puts a particular unit of a transmission line out of service, but this is not due directly to an excessive voltage gradient in the material of the insulator It is frequently brought about by the unequal expansion of the hardware and the porcelain to which it is cemented, which develops small cracks and starts the trouble The porcelain itself should be of a kind which will resist sudden changes of temperature It is now manufactured to withstand alternate immersions in boiling and freezing water without developing cracks, and porcelain bodies have actually been made which can stand being brought to a red heat and then plunged into ice water, without developing cracks

The Arc System in Radio.—Advocates of the arc system of radio communication claim that theirs is the best method for unfailing, regular communication by radio over long distances Generating continuous waves, the arc system has all the advantages of Maximum power input to a given aerial system, enabling a cheaper and smaller aerial system to be employed to transmit over a given distance, or increase of range of an existing station by substitution in place of a damped wave generator Greater selectivity in reception with consequent greater freedom from interference and atmospherics, thus rendering the service less liable to interruption Heterodyne reception, giving improved signal strength and choice of audio-frequency to suit the operator with still further freedom from interruption.



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The Canadian carbonizing and briqueting plant now building at Bienfait, Sask., in the heart of the lignite district

American Lignite Coals

Canada Blazes the Way to Put Them on a Par with Anthracite

By Robert G. Skerrett

> *IN a recent issue, Mr. Skerrett told us something about the brown coals of Germany and the success with which they are being utilized in a manner that puts them right on a par with anthracite. There is something fascinating in this idea of taking deposits that if left to themselves would become hard coal a few million years from now, and in a few hours converting them into the fuel equivalent of hard coal. In a sense the processes of geologic ages are accelerated so that they are brought to their conclusion in hours or even minutes. And now we learn that what has been done in Germany is being done in Canada and may be done in the United States, with the enormous deposits of low-grade coal existing in the great Northwest.*—THE EDITOR.

CANADA'S fuel problem has brought about action on the part of the Dominion Government that is no less important to us than it is prospectively to our northern neighbors. The work of the Lignite Utilization Board of Canada will shortly bear fruit through the carbonizing and briqueting plant now rapidly nearing completion near Bienfait in the Province of Saskatchewan, just across the boundary line of North Dakota. The establishment is designed to have an annual capacity of 30,000 tons of lignite briquets, costing, loaded on cars, about $7.50 a ton at the works. Each ton of this fuel, as amply demonstrated, will have, when burned in the domestic furnace, substantially the heating value of an equivalent unit of anthracite coal. Two tons of lignite will make a ton of briquets.

While the fuel resources of Canada are both great and varied, their geographical distribution unfortunately leaves a vast region, lying between the bituminous coal deposits in the neighborhood of the Atlantic Coast and the lignite beds of Saskatchewan, destitute of natural fuels save such as peat and wood. The coalless industrial districts of Quebec and Ontario are in this unfavored area, and, accordingly, these provinces, together with Manitoba, must in the main obtain their coal from the United States. This situation has not unreasonably been viewed by the Dominion Government as "an industrial menace and a national problem," hence the steps that have been taken to turn the native lignites into a really efficient fuel.

Up to now, the fuel question in western Canada and particularly in Saskatchewan has bristled with physical and economic difficulties. Into that region there has gone annually in normal times, from the anthracite mines of Pennsylvania, quite 500,000 tons of coal, representing to the consumers an outlay of about $6,000,000. In addition to this fuel, so it seems, householders have used large quantities of the native coal owing to its cheapness, but the stuff is dirty, breaks up easily and disintegrates quickly. In short, it is objectionable in use, and relatively low in heating value.

However, underlying the Province of Saskatchewan and reaching southward into Montana, Wyoming, and the Dakotas are immense deposits of poor lignites. These beds cover more than 13,000 square miles, and are estimated to hold 59,812,000,000 tons of the fuel. The lower seam of these lignites is deemed commercially the more important, for it attains a thickness of eight feet, yielding 11,000 tons an acre, or substantially 10,000,000 tons to the square mile. Better lignites and bituminous coals occur in Alberta, but for economic reasons, the Canadian authorities very sensibly set themselves the task of finding a process by which the Saskatchewan lignites could be made nearly comparable with anthracite—realizing that if they achieved this they would incidentally have at hand the means by which to briquet the higher grade lignites of Alberta.

At the very start, the Lignite Utilization Board availed itself of all information obtainable in the United States and in Europe, and then bent its energies to dealing with the circumstances immediately confronting them, seeking the while to employ to advantage any domestic media that would be likely to keep down the briqueting cost. After the examination of a large number of samples of Saskatchewan lignites, the average composition was found to be as follows:

Moisture	26.13
Volatile hydrocarbons	28.11
Fixed carbon	38.16
Ash	6.86
Sulfur	0.74

The mean of the products of carbonization of a ton of these lignites was:

Gas	10,000 cubic feet
Oil or tar, waterfree	15 gallons
Ammoniacal liquor	65 gallons
Carbon residue	935 pounds

Experience has shown that lignite carbonizes much more readily than bituminous coal. This confirms the investigations of our own Bureau of Mines, which discovered that lignite does not coke in the sense that bituminous coal cokes, but crumbles on being carbonized. This action facilitates a continuous and a comparatively inexpensive distilling process, and obviates the laborious and costly charging and drawing of retorts as practised in coal-gas plants. Further, lignite parts with its volatile content more readily than is the case with bituminous coal. The most rapid evolution of gas takes place at the comparatively low temperatures of from 700 to 900 degrees Fahrenheit; and substantially all of the gas is released when 1,000 degrees is reached. The gas has a heating value of 400 to 450 British thermal units to the cubic foot.

According to the Report of the Canadian Research Council, there is more gas in a ton of lignite than would be required to carbonize another ton of the raw material. Assuming that it takes 6,000 feet of gas to carbonize a ton of lignite, each ton undergoing treatment would then supply an excess of 4,000 cubic feet which could be used for other purposes, among these the generation of power. Inasmuch as the average gas engine consumes 10,000 B.t.u.'s per hour per horsepower, 4,000 cubic feet of the gas would supply motive energy for 160 horsepower-hours. The ammonia by-product of the carbonizing process can be made available as a fertilizer, for use in refrigeration, or as an ingredient in the manufacture of explosives, while the oils and tars, resulting from the distillation of the lignite, have many fields of application. The Lignite Utilization Board, however, has centered its efforts upon developing a satisfactory briqueted fuel primarily for domestic consumption. The Canadian authorities have watched with alarm the steady upward trend of the price of coal obtained from this country, and they sensibly are seeking to anticipate the day when the United States will, in all likelihood, place an embargo upon the exporting of anthracite. As they figure it, the cost of lignite briquets will drop with greater production, and the use of that fuel will widen directly in proportion to the volume of output.

The plant at Bienfait is the climax of carbonization experiments which have passed successively through small-scale laboratory tests, large-scale laboratory tests, and semi-commercial tests; and thus the Fuel Utilization Board has reached the conclusions which have warranted the Provincial Governments of Manitoba and Saskatchewan and the Dominion of Canada in appropriating a total of $400,000, of which fully $370,000 will be expended in rearing and equipping the works. This is a tidy sum, but the outlay will soon justify itself. With the briquets bringing $7.50 a ton at the factory, the transportational charge amounting to $1.50 within a radius of 150 miles, and allowing another $1.50 for a dealer's profit and cost of delivery, the ultimate consumer would then pay but $10.50 a ton as against something like $15 now asked in that region for Pennsylvania anthracite. This represents a potential saving of certainly $4 a ton; and with a plant output of 30,000 tons yearly, the householders would be the better off each twelvemonth by $120,000. Further, viewing the matter from its broader economic aspect, the Dominion would keep within its boundaries annually $450,000, while laying the foundation for a domestic business susceptible of tremendous expansion.

Much like the brown coal of Germany, the lignite of Saskatchewan is so deficient in inherent binding material that a briquet made without the addition of a

(*Continued on page 355*)

Recruits for the World's Biggest Fish Show

By James Anderson

NO one thinks of visiting New York without taking in the Aquarium, and these visitors can testify to the fact that the unique job of acquainting Americans with the fish that swim in the waters of the new world is well done But the question naturally arises in the minds of the six thousand-odd persons, from all parts of the world, who daily go there to pay their respects to Mr. Fish—how are the multitude of living specimens procured?

This is an important feature of the business of the Aquarium, not only constantly to put on what is positively the greatest fish exhibit on earth, but to recruit the cast of performers in the show. Devious means of procuring the specimens have been tried, including exchange and purchase, but the best method has only recently been put into effect

Realizing that its collection, great as it is, is by no means complete and that there are still just as many interesting, rare, curious, and freak fish in the sea as ever were caught or displayed in the Aquarium, its management has gone into the sport of fishing on a larger scale than ever before The Aquarium is now equipped with its own fishing boat, which shoves off once a week from its New York dock and returns loaded down with thousands of additional specimens of the finny clan

This supply ship, christened "The Seahorse," is unique among fishing craft Instead of going out to catch fish for food, with hook and line, it hunts them in nets, and the greatest possible care is taken not to injure the catch but to keep them alive and well To do this the "Seahorse" is separated amidships by water-tight bulkheads from the fore and after sections The middle section is similar to a well, and is provided with a constant change of sea water through many holes bored in the hull The well is 11 by 10 feet at the bottom, of such goodly size that the fishermen are enabled to land alive in New York anything which they may catch

The "Seahorse" is not a big boat as fishcraft go, being only thirty-five feet in length over all; but she is thoroughly seaworthy and most scientifically arranged For power she uses a two-cylinder, four-cycle Frisbie engine, and in case this should break down, she is equipped with a suit of sails

This boat has been in operation only since June but has already proved its value, having been the medium of bringing additional hundreds of the finny tribe into the tanks of New York's gigantic fish show Already she has made about twenty trips to sea, returning with a total of about 18,000 fish The trips are made about once a week and each jaunt is of approximately twenty four hours' diversion, the boat going quite a distance out past the fishing banks, the mecca for fishermen from the metropolis On its autumnal trips it has been able to get more interesting and valuable specimens than was possible early in the summer due to the fact that during the latter part of August and early September many odd specimens of the finny tribe come northward from tropical seas

Ponder for a moment, you amateur wielders of the rod, and think of this day's catch of the crew of the "Seashore": 1 cow-nosed ray, 9 dogfish, 20 weakfish, 40 puffers, 4 daylight flounders, 3 sea robins, 3 blackfish, 10 young mackerel, 20 spots, 12 crockers, 11 fluke 2 bluefish, 1 sand shark, 2 lobsters 20 rock crabs, and 6 king crabs Many of them are of course ordinary, but the "Seahorse" has just started, and what bait slinger would not be satisfied with such a catch?

The Aquarium has put is own fishermen to work at a most opportune time as due to various reasons it is now dependent almost entirely on the boat for additional members to the cast of the great fish show This has come about because neither railroads nor steamships have, due to freight congestion, found it possible to stock its tanks with new fish as in other years Also many of the boats which formerly brought fish to the Aquarium have experienced trouble in the matter of hiring help and have consequently quit fishing But with the aid of the "Seahorse" the stock of the tanks has been repleted to such an extent that the Aquarium has just been enabled to exchange some rare and choice specimens with the Boston Philadelphia, and Detroit Aquaria, which were badly in need of them

Among those freaks now present in the Aquarium tanks, thanks to the work of the "Seahorse," may be mentioned the puffer fish, well named because upside down or right side up he can relax to normal or blow himself up to four times his natural size Then there are the shark suckers, very odd chaps that somewhat resemble a flotilla of submarines in dead storage They take their imprisonment on indeterminate sentence philosophically

The prickly ray, a somewhat angular freakish specimen of the deep, must not be overlooked, as he has

(*Continued on page 357*)

Left: General view of the vessel, which measures only 35 feet long, over all. *Right:* Removing specimens from the tanks aboard the "Seahorse," to be conveyed to the aquarium

The "Seahorse," craft with which the New York Aquarium conducts its search for fresh material

The rate at which moisture advances through the sand in this inclined trough indicates the speed at which capillary action robs the irrigation ditch of its water

What Happens to Ground Water and Why

By S. R. Winters

AS a thief in the night, the water supply of irrigation canals is absorbed and robbed by the soil which is necessarily given quarters in the conveying channels and impounding reservoirs of the arid region of the West Capillary action is the force in operation which is credited with appropriating water not accounted for by direct percolation and evaporation The irrigation engineer has heretofore found scant information on the subject, hence the value of a series of experiments recently conducted by the Drainage Division, United States Bureau of Public Roads, under the direction of the senior irrigation engineer of its Berkeley, Cal., laboratory

What is the significance of capillarity as an agency in stealing water from irrigation works, does it play a conspicuous part in distributing, within the soil, moisture applied in irrigation, and whether it conspires with plant growth along the canal bank in consuming water designed for producing crop wealth on arid lands—these and similar questions prompted the scientific study which required special apparatus Duration and frequency in the distribution of harnessed water constitute an uncertain equation of constant concern to the irrigator. Uniform distribution of water and the maintenance thereof cannot be ignored if dry lands are to be transformed into crop producing areas. Likewise economy in the application of water is a factor when even the offerings of the clouds are not to be had for the asking Obviously, the capillary movement of soil moisture is not foreign to the proper construction and operation of conveying channels and impounding reservoirs—avenues for the economical application of water to the fields

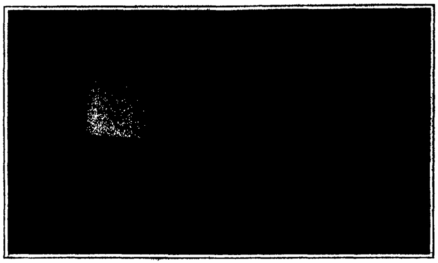
The tests were pronounced in their conclusions that the movement of moisture by capillary action is much slower and not so extensive in the absence of free water as in the presence of the latter Gravity plays a conspicuous rôle in the capillary movement of moisture when wet and dry soils come into contact The force of capillary attraction is greater in a horizontal direction than the upward tendency in vertical boxes, but not so great as the downward movement If the variation in movement of moisture in the several test boxes, as representing the upward, downward and horizontal positions, is primarily attributable to gravity, the conclusion of the government irrigation engineer is that Newton's law is the outstanding influence in the capillary distribution of soil moisture

The rate of movement of moisture as sketched on a diagram, shows its progress in the lighter soils is more rapid for the first few hours and then slackens its pace more quickly than with the heavy soils The heavier soils maintained a more uniform variation than the lighter soils throughout the experiment The light Idaho land, for example, evidenced a variation of nearly 250 per cent in the total distance moved during

(*Continued on page 357*)

The Vest-Pocket Automobile

European Super-Flivvers that Are Designed to Get 75 Miles, or More, Out of a Gallon of Gas



One of the lightest of the British attempts to compromise between the automobile and the motor bike

THE price of gasoline is one of the questions of the hour to the large and ever increasing automobiling public. The figure at which the elixir of life for Tin Lizzies and Sumptuous Sixes retails is *not fixed*, *to borrow an expression from the Einstein Editor and his followers*, it is "fixed with respect neither to time nor to place." At one time during the past summer two commuters from different parts of New Jersey found on comparing notes that while one of them was paying 37 cents for the indispensable fluid, the other was getting it for 33, while in Newark, half way between their respective home towns, it was to be had for 32, 31, and even for 30 or 29½ cents. Again, the price in one of the communities to which these remarks apply has within the past four months dropped from 35 to 26 cents, where it remains quite firm.

If the automobile owner of some years standing feels that these prices are inordinately high in comparison with those of the days when he used to get the very finest brand of liquid lightning for 9 cents, and when he cried out to high heaven that he was being robbed if the proprietor of some roadside establishment far from the center of things demanded 11 cents, he doubtless has reason for this feeling. But if he will compare his present situation with that of the British or Continental car owner he will find that he has *a good deal to be thankful for, after* all.

For one thing, granted that he has the price, he can get gas wherever he wants it, whenever *he wants it, and as much as* he wants. Over large regions of the Continent, especially in the territory east of the Rhine and the Alps, there are practically no supplies of gasoline outside the very largest cities, and little enough in them. He who would make a trip of any magnitude must necessarily carry with him all the fuel he will need to get him to his destination, for he will hardly find any on the road at any price at all. And even in the countries like England and France, where "petrol" is theoretically available, the unfortunate motorist who runs out of it may have to pick it up here, there and the other place by the quart or even by the pint. This is to be taken literally, and not at all as a figure of speech. When gasoline is rationed in England, which is pretty much all over the Kingdom and pretty much all the time these days, the quantity which it is allowable to buy in one place at one time is prescribed in pints—and sometimes it doesn't come to enough pints to make a gallon. And as though things had not come to a sufficiently desperate pass when the owner of a huge six-cylinder, seven-passenger bus of ancient vintage that was a *gas hog* when it was new has to figure his fuel requirements in terms of miles per pint of petrol, he is charged for it—when he can get the stuff at all—a price which at present exchange rates comes to something like 75 cents per gallon.

With this condition more or less prevalent all over Europe, it is not difficult to understand the current trend of automotive design on the other side of the water. Even in the United States engineers and designers are taking cognizance of the fuel situation, both as regards quality and as regards price. Their efforts so far have been confined to new carburetors and new attachments for carburetors and for intake manifolds—attachments that go to make a very lean mixture sufficiently explosive so that the car may run with a carburetor adjustment that would ordinarily mean instantaneous stalling. But while this moderate expedient is adequate, *for the present*, *for whatever of* gas problem we have here, it would not do in Europe. The difference between 16 and 32 miles per gallon is considerable but not enough. So throughout Europe we find a concerted effort to put on the market an instrument of travel which shall, in general terms, combine the fuel performance of the motorcycle with the roadability of the automobile.

Another English model built along somewhat novel lines

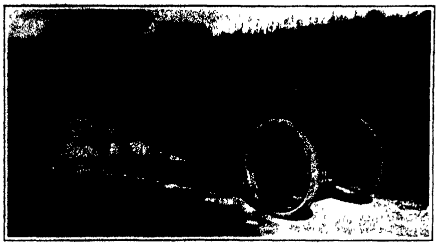
The most extreme of these baby conveyances that we have seen is the one which we illustrate first. It is of British make, and is hardly an automobile at all, being rather distinctly a motorcycle in all respects save those of wheel arrangement and chassis lines. It is strictly a one-passenger affair, as are a good many *of the vehicles of the latest vintage, and it is claimed* to be the smallest, lightest and cheapest thing of its sort in the world. The makers, of course, claim that it is the smallest, etc., *automobile* in the world; but we refrain from repeating this claim verbatim through doubt as to where the automobile ends and the cycle-car begins. In any event, it is driven by an engine that is strictly of motorcycle type; and the whole outfit, engine and all, weighs no more than 150 pounds. Its price of 79 guineas compares favorably with the usual cost of small cars of European manufacture, though in this country it could hardly compete with the standard 510-dollar variety. Its fuel consumption is not stated, but undoubtedly it will go 75 miles on a gallon, if not more.

Another British design of much ingenious novelty is the apparatus of our second photograph, with its strong suggestion of the lines of the wheeled invalid's chair. Here the driver and his passenger are accommodated out in the open air, rather than being given a place actually in the machine, which lacks a body altogether. No details of its performance or weight are vouchsafed; but it will be noted that like most of the breed, it goes in for tire economy as well as low fuel consumption. This of course is very fine in buying the machine new; but we can easily imagine circumstances under which it would be utterly impossible to replace a used up shoe of such bizarre dimensions. Even in this country, users of the less usual small cars taking tires 28 by 3 or other odd sizes are sometimes rather *badly up against this proposition*. But if the problem were to be solved by the purchase with the car of enough spares to guard against emergency, and by the certainty that the manufacturer of the car was a permanent institution and would not blow up early next week, the main disadvantage of this style of conveyance, as we see it, would be eliminated.

The three-wheel feature is almost universal in these light cars that look toward a greatly increased gasoline mileage, and for the most obvious of reasons. Even when the vehicle attains a quite ambitious size, it continues to go on three supports, though opinion seems about equally divided whether the single wheel should be in front or at the rear. A German model in which the former alternative is selected enjoys the rare merit, according to the gentlemen interested in its sale, of taking the street corners at full speed without danger. It is not specified whether it rolls about them *on two* wheels like *a* bicycle, *or* whether its lightness enables it to fly around them or to jump over them; so there seems to be a certain degree of *non sequitur* about this claim, which however we repeat for whatever merit it may have. Perhaps the most noticeable feature in the photograph is the obvious fact that if anything goes wrong with the controls, the driver will not have to lift the hood to find out where the trouble lies. We opine that if this machine were to become general, the degree to which the machinery-struck small boy could stand on the curb and watch the internal workings function on the passing cars would soon lead to a generation of natural-born garage mechanics. Seriously, however, we want to suggest that some of our American manufacturers, without at all copying the eccentric lines of this goose-neck affair, might well emulate it with regard to accessibility of some of the major parts that require frequent adjustment, like—well, to be disagreeably specific, like the timer. We are quite certain that the driver of our picture will not have to tear down any radiator to find whether the failure of his machine to develop a spark is due to commutator trouble.

A German three-wheeled car of rather ambitious proportions

Doubtless the most auto-like of all the machines which we show is that at the



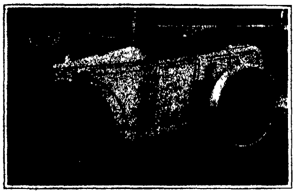
A British "light car" improvised from a cycle car

top of our second page, which is a car reconstructed by Mr. Angus Love, of London, from an ordinary cycle car. Mr. Love assumes that under the disguise of roller blind and other home-made "improvements" (the quotes are his) we will recognise this; but we are not at all sure that we should. At the time of sending us the photograph, in December, Mr. Love had operated the machine for nine or ten months, covering several thousand miles with two up plus luggage—which for the provincial American may be translated as baggage. He tells us that the car as illustrated, with fuel and oil and electric light, weighs 500 pounds. We think for the extra 350 pounds it makes a very respectable showing beside the first of our pictured types. It is driven by an 8-horsepower twin-cylinder air-cooled engine—the features of two cylinders and air cooling being quite general among the machines which we are describing. The transmission is by chain to a three-speed gear-box and thence by a one-inch rubber belt to the solid rear axle. It will speed up to 45 or 50 miles per hour on the level, and it will of course hold its own with anything on the hills. The fuel consumption is about 68 to 72 miles per gallon with gasoline or 75 to 80 with benzol. The car is rather superior, apparently, to most of its fellows in the excellence of the springing and in the general comfort which it affords. Mr. Love states that he did a run of 235 miles from London to North Devon in one day, using up 13 hours of time including stops for meals, and 8¼ gallons of fuel. He considers that this ought to "give the designer of the conventional automobile furiously to think," and with fuel at 75 cents a gallon we should suppose it might. The car, in its present state as we understand it, cost him 165 pounds. Incidentally, if everybody who takes occasion to show us one of these things would tell us about it as fully as Mr. Love has done, we should consider that the world was getting better.

Strongly along bath tub lines is the German electric which we illustrate next. A curious feature of this machine is that the steering column is adjustable, so that it describes a graceful circle about the person who is getting aboard, instead of forcing him to climb over, around and under it. We have ridden in regular automobiles where something of the sort would be an improvement. This machine weighs 300 pounds and takes a load of 200 pounds additional without protest. It travels at a speed of from 2 to 25 miles per hour, indicating that it could not be driven on American roads without the certainty of getting run over. It goes 50 kilometers (30 miles) on one charging of the battery—we should suppose that with slight additional permanent weight this showing might be materially improved. It develops one-half horsepower at 8 volts and 200 amperes. It seems to be rather similar to the "Electrisches Kleinautomobil" recently illustrated in these columns.

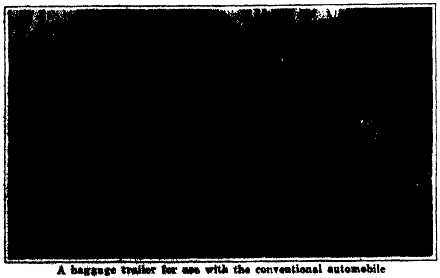
A Swiss motorized tricycle which it is difficult to accept as more than a toy is the next item on the list of near-automobiles. The most surprising feature of this one is its low weight of 32 pounds. It is suggested that it will develop a brand new economy of its own, in that after using it, the owner can tuck it under his arm and take it upstairs to his apartment, about as we used to do with our racing bicycle in the days when we lived three flights up. Whether he is to park it under the kitchen sink or behind the bed or hang it on the hatrack is not specified, the point of the argument being that the expense of garage hire is nothing in the life of the proud proprietor of this pushmobile. The cost is moderate enough, being only 650 francs (of the Swiss variety that are still worth 17 cents). Gasoline mileage is not specified, but if it is inversely proportional to the weight it must be sufficiently enormous.

Our last picture has to do with an attachment for the regular automobile. It is always a problem, especially in the case of a closed car, to know just how to deal with a trunk. We should doubtless be startled to encounter this trailer on the road, but if driven into a corner and pressed to state exactly what is the matter with it we should be at a loss to particularise. Architecturally it certainly is a part of the car that hauls it, and if this were of different style from that shown in the picture it could be made a part of it. And with the great vogue of auto-camping the spectacle of a passenger car towing a freight trailer is not so entirely unique as it was at one time. Indeed, we met a dilapidated vehicle of indeterminate age and make the other day on the Lincoln Highway a few miles out of New Brunswick, which surprised us a good deal more with the tremendous variety of things that it had tied and strapped to it than it could possibly have shocked us if these appurtenances to life on the road had been decently stowed away in a trailer of some sort.



A German electric weighing but 300 pounds

A Swiss "machine" that weighs but ten pounds more than the ordinary bicycle



A baggage trailer for use with the conventional automobile

Long Hollow Steel Bars

AN order of a unique character has just been placed in Sheffield for 160 hollow steel bars, each measuring 62 feet long by 2 inches in diameter, to be used as rock-boring drills. They are by far the largest drills ever made for such a purpose, as the length of the hollow bars hitherto rolled has averaged from 10 feet to 12 feet, and even then the difficulties of production have been considerable. It would not be possible to do the work contemplated but for the existence at the local armament works of mills of exceptional power and size. The bars are to be rolled from 8-inch square blooms weighing nearly half a ton each. A hole is first drilled through the length of the bloom and plugged, and the stopping is removed on the completion of the rolling process. The purpose of the hole in the bars is to provide a passage for water or lubricant. The transport of the material through the streets will have to be done during the night-time, and a dray is being constructed especially for the purpose. The placing of this order in Sheffield by an American firm is a tribute to the efficiency of Sheffield plant and workmen.

Belgian Experiments on Palm Oil as Motor Fuel

A SERIES of experiments begun in 1914, but interrupted by the war, has recently been resumed in Brussels on the use of palm oil in internal-combustion motors. The question of motor fuel in the Belgian Congo is a serious one, since a ton of crude oil delivered at Kinshasa in metal casks has an estimated price of 2,000 francs, as against 1,050 francs in Brussels. Palm oil, on the other hand, costs on the native market an average of 25 centimes per kilo, but varies in price between 8 and 40 centimes. The calorific power of palm oil is from 20 to 25 per cent less than that of crude oil, so that a relatively larger consumption of palm oil must be reckoned with, while the comparatively high temperature at which palm oil fuses (87° C.) indicates the possibility of rapidly clogging the motor.

According to engineers closely connected with the experiments, without constructing a special palm oil motor, it was necessary to find a machine in which complete combustion is assured by a complete vaporization of the fuel, which should be introduced in a quantity strictly proportionate to the load. It was further essential that the gaseous mixture should be constant and capable of regulation by a supply of water, varying according to the load and the amount of oil being fed in. Thorough clearing of the exhaust gases was also a requisite.

The Belgian colonial company for the Congo has been successful in finding a two cycle semi-Diesel motor of Swedish manufacture developing 10 horsepower at 500 revolutions per minute which satisfies these conditions, and motors of larger and smaller sizes of the same character have been run on palm oil with good results without special changes for the use of the new fuel. The palm oil, which at normal winter temperatures in Belgium has about the consistency of soft butter or lard, is placed in a tank divided into three compartments by wire screening. As this tank is heated either through the circulation of hot water from the cooling system or other mechanical means the palm oil liquefies and passes through the screening to the feed pipe leading to the injection pump. For experimental purposes this motor is started on crude oil. Once it has warmed up, and as soon as the palm oil begins to liquefy, the crude oil is turned off, so that the engine then runs on palm oil exclusively with no slackening of the number of revolutions or of the power produced. At the temperatures prevailing in the Congo, engineers claim that this motor could be immediately started on palm oil and it is proposed to install motors of this type on launches and other small river craft, as well as to conduct further experiments for their use in industry and traction. Analysis shows that there are no incombustible components in palm oil, and, contrary to general expectation, the oil neither clogs the motor nor leaves any perceptible solid residue behind it.

"Banking" Electricity for Universal Use

Making Use of Water Storage and Transmission Lines for Providing Power at Low Costs

By Professor Reginald A. Fessenden

ELECTRIFICATION *can be applied universally by* means of a simple and extremely practical system of "National Power Banks" from which electric power can be withdrawn and in which it can be redeposited by consumers at any desired time

These National Power Banks" can be spread throughout the country being established in or near large cities or wherever most convenient They can be used both for main and subdistribution of electric current Their establishment will enable power generated at gigantic stations located in the coal regions of Pennsylvania or elsewhere to be delivered and stored at Boston, New York, Philadelphia, Washington, etc, *i e*, all over the United States The cost of the power, delivered at Boston or New York should not exceed one fourth of a cent per kilowatt hour

Establishment of these banks would not mean that the present power stations in New York and Boston etc, should be abandoned, for they generate power themselves at a rate of less than a cent per kilowatt hour, and by connecting on to the storage network, and so *being able to run at unity power factor*, can reduce production cost down to nearly one-quarter cent per kilowatt hour They will make their great saving, however, in the secondary distribution, which at present is the most expensive and wasteful part of the system, by using storage at points in the secondary distribution, and pumping their access power at night time back into the power bank

These banks would not be rich men's banks All over the country districts any farmer with a windmill can hitch on an asynchronous generator to his windmill, with a sealed reversible meter, and, leaving his windmill run all night, get credit for the power pumped by him back into the storage network, and be debited with what he *takes out* Such *an arrangement* is shown in our drawing on page 341 During the long winter months he should have a substantial balance, unless he uses it for heating which becomes quite practicable with the low cost of generation and delivery rendered possible by the power banks

One obvious effect of the existence of such a storage network is that local dislocation of business due to coal shortage, etc, will be eliminated Numerous other obvious good effects of such a system could be cited

The conditions necessary for universal electrification under my power bank plan, or any plan, are Low cost of generation, low cost of transmission and low cost of distribution

Low cost of generation depends very largely on power factor – the percentage of power being utilized *of the total generated* – and we will assume first a 33 per cent factor Administrative geniuses like Insull in Chicago have done much better, but 33 per cent is more nearly representative of ordinary conditions

(*a*) Generation from coal This is at present the cheapest method for large quantities Using extra large Detroit type boilers and 50,000 kilowatt turbo-generators located at the mine mouth, the cost will be in the neighborhood of one-quarter cent per kilowatt hour

(*b*) *Generation by water power* This is the next cheapest, and will average about one half cent per kilowatt hour

(*c*) *Generation by tides* In 1909 I made a very complete investigation for some Montreal capitalists of the possibilities of the Bay of Fundy Several quite *practical alternative schemes were laid out, and it was* found that the cost would be slightly less than one cent per kilowatt hour The engineering problem was a quite simple one A fundamental difficulty existed, however, *i e*, that after the power was generated there was no body of users near enough to utilize it So the project was dropped

(*d*) *Generation from solar heat* The latest value of the Langley radiation constant is about 2 calories per minute per centimeter square This means approximately the energy of one Niagara Falls for each square mile The constant is as a rule larger in winter than *in summer on account of the greater* transparency of the atmosphere, the largest values having been found in winter in Siberia As I have pointed out elsewhere, this method is not limited to daytime, as negative radiation may be used at night time, cooling the vapor from sea water after passing it through a low-pressure steam turbine Some calculations I made show that a negative radiation plant operating in Alaska in winter would have about the same power output per dollar of plant as a positive radiation plant operating in summer in the tropics

The method used would, of course, be low-pressure steam turbines of large capacity and the water flowing in this stream over the surface of large shallow tanks, covers of suitable absorption band glass, good condensing facilities, etc In a paper read before the British Association in 1910 and printed in full in the London *Times*, I have given tables of the average calories received during the entire year per square centimeter of ground surface The cost per kilowatt hour of power produced by this means is at present about two cents per kilowatt *hour* It will undoubtedly be reduced in the future, and it is evident that such places as the Desert of Sahara will before long be as valuable as coal country Underground waters exist over a great part of the Arabian and some other deserts

(*e*) *Generation by wind power* A 500-foot windmill may be relied upon to produce an average of 1,000 kilowatts at a cost of about 8 cents per kilowatt hour A windmill is, however, an extremely wasteful means per dollar of cost of construction for taking power from the wind, and with more scientific construction the cost can be brought down The problem of placing windmills behind each other (or other energy absorbing structures) is a quite amusing one At first sight it would seem as if the shielding effect would be enormous because the problem has the appearance of being related to the diffusion of heat through a gas But in reality the problem is one of large scale convection, and calculations and experiments show that the shielding is relatively small and that wind energy conyects downward at a very rapid rate behind each energy absorber

(*f*) *Generation from Internal Heat of Earth* This has been discussed so thoroughly by Sir Charles Parsons that it is sufficient to say that it appears thoroughly practical, and at a reasonable cost. It is simply a question of the value of the ratio of rate of heat diffusion through rock to cost of excavation, which does not vary with the size of the plant (above a certain size)

With all the above sources, the price at which the power can be sold at the gigantic generating stations will vary inversely as the power factor, because in each case if the plant is sufficiently large and properly designed and located, the fixed charges will be by far the main item Therefore, if the power can be stored at negligible cost, so that the generating stations can deliver their full capacity at all hours of the day and night, *i e*, if they have 100 per cent power factor, the cost of production per kilowatt hour will be as follows:

(1) Coal—one-tenth cent per kilowatt hour.
(2) Waterfalls—one-fifth cent per kilowatt hour.
(3) Tides—one-half cent per kilowatt hour.
(4) Solar heat—one-half cent per kilowatt hour.
(5) Wind—one-half cent per kilowatt hour.
(6) Internal heat—not unreasonable

Low cost of transmission depends on the resistance and corona losses and power factor and transforming apparatus cost

As regards resistance, when I was designing my transatlantic wireless stations at Brant Rock, Massachusetts and Machrihanish, Scotland, in 1905, I was faced with the problem of providing strain insulators to operate under a stress of 100 tons, and a voltage of 1,000,000, at a frequency of 250,000 and with 100 kw of energy behind the voltage No such insulators were known, but I found that by putting a number of insulators in series in such a way as to keep their mutual capacity small and placing shields so as still further to equalize the electrostatic stress curve, the thing could be done; and though the towers frequently were operated at the full million volts for hours at a time, and though a tower was sometimes struck two or three times by lightning in a single night, there was only one instance in five years of insulator loss It may be said, therefore, that it is quite possible to insulate transmission lines up to at least 500,000 volts

Another difficulty is the corona loss. This also was overcome so that there was no measurable or visible corona loss up to 1,000,000 volts with wires only one-tenth inch in diameter The method was very simple, but would take too long and is too mathematical for insertion here, but it means that if there is sufficient power transmitted to make it worth while, corona loss can be eliminated at negligible cost

Power factor is always bound to make trouble unless storage is used If the power is stored, the power factor can be kept at unity and a lot of trouble from surging, etc, eliminated

Without storage, transforming apparatus must always be used, and must always be quite expensive If the power is stored, transforming apparatus, *i e*, primary transforming apparatus, can be eliminated

In cost of conductors, especially with high power lines, the cost of the whole transmission line depends not only on the voltage but also on the power factor. If, for example, the power factor is 33 per cent and the peak is 300,000 kw., obviously, if storage is used so that the power factor is unity, the line need only be of sufficient size to carry 100,000 kw., and since the maximum loss in the line is I^2R, the conductor can have one-tenth the cross section; or, if the same size conductor is used, may be ten times as long, *i e*, power may be transmitted from the big generating stations over an area 100 times as great as before. [I represents current; R the resistance]

This is not really a fair comparison, but this whole subject of economical line design is extremely complicated, and what I have said is very nearly correct, though other mutually canceling considerations come in To take a specific case, power is at present being delivered at Copenhagen, in Denmark, from Sweden, through a submarine cable. Assume Copenhagen's power factor to be 33 per cent. Then, *obviously, if* storage were used, three times the power could be transmitted through that cable for the same transmission cost. And even more, for direct current high voltage current could be used, with still further reduction in cost; and, for the same insulation strain on the cable, six times the power could be transmitted, thus reduc-

(*Continued on page 357*)

PROF. REGINALD A FESSENDEN, originator of the "National Power Banks" plan of storing electricity for universal use, is a well-known figure in the electrical world, both in the United States and European countries His system, explained in the accompanying article, was under consideration for installation, in part at least, by the Danish government when the Great War broke out, and the matter was dropped for the time being In conjunction with wind power, the system is being considered for New England and the Eastern States. Inventor of the wireless telephone and the electrically driven battleship, Professor Fessenden was, in 1909, the first person ever to telephone across the Atlantic. Among his other inventions are an iceberg detector, a smoke-cloud protection for British tanks, used extensively at the Battle of Cambrai, and a method of locating enemy guns by sound The last invention was perfected by Professor Fessenden while he was acting as a technical expert for the Canadian government during the Great War

Professor Fessenden was one of the engineering commissioners of the Ontario Power Commission which, in 1906, planned and recommended the distribution of power from Niagara Falls over substantially all of Western Canada The difficulties met with by the pioneers in this work were overcome by Professor Fessenden's invention of the series of small electrostatic capacity insulator, capable of carrying potentials up to 1,000,000 volts. With all this behind him, Professor Fessenden may put forward a scheme like the one here described with no danger of being branded as an impractical visionary —THE EDITOR.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

The Einstein Contest and the Readers

To the Editor of the SCIENTIFIC AMERICAN:

I have read Mr. Bolton's article with a great deal of interest. It is capital, concise, and excellent in every way I have enjoyed it thoroughly, and I only hope that the average reader of the SCIENTIFIC AMERICAN will enjoy it as much.

I now have a suggestion to offer, of which the practicability depends in part on how much you propose to publish of the other articles You have now found the paper which experts believe will give the most instruction to the readers of the SCIENTIFIC AMERICAN Why not find out now which article the readers themselves think is best adapted to their wants? Why not publish a few of those papers that you personally consider the best, and let your readers vote on them? It seems to me that if the papers are carefully selected, such a vote would furnish a very unusual opportunity to secure valuable information, not only to the editor, but also to others, as to the mentality of the average intelligent public W H PICKERING.

Harvard College Observatory,
Mandeville, Jamaica.

To the Editor of the SCIENTIFIC AMERICAN:

Bolton's essay on Relativity is a master composition in the English language let alone being of supreme interest as a popular exposition of Einstein I must have a copy for my library as one of the treasures of literature LEE H. MCCOY, Pueblo, Col.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of February 5th you published an essay on Relativity, followed by a second essay on the same subject in your issue of February 19th. I venture to think the second essay is the better of the two

This opinion is not of any value but the process by which it is arrived at may interest you

The first writer is a scientist who speaks and thinks fluently in scientific language just as a Frenchman does in French; there is no trick about it, it is the easiest way Thus this writer deals freely in abstractions and as little as need be in concrete things The second writer deals as largely as possible in the concrete and projects his own abstractions as he needs them taken by the arm, the reader, before he is aware of it, has achieved an altered attitude of mind, for example.

Both writers deal with four dimensional space from the same point of view, and in the same way, but the second writer has a nimbleness all his own: When his reader has gone over the matter a second time he has already convinced himself that four dimensional space is according to regulations that he had always thought so, that three dimensional space is only an abstraction that he had never quite understood why people took it seriously, "don't you know." The first writer has another sort of nimbleness, he entangles his readers in his graceful involutions of expression, it is obviously the reader's business to disentangle himself as best he can. It implies that the reader has intelligence to share, and he lets it go at that.

You may claim, I think, that the first writer prepares the reader's mind for the second The second writer does not seem to need a John the Baptist to prepare the way before him The first is Brutus, the second is Mark Antony Doubtless the judges are able, scientific people; perhaps it was a layman's job, or, rather perhaps, this is an example of relativity It is admitted that your choice is valid from the scientific system; may not my choice be valid from the reader's system? CHAS. STRANGMAN.

Victoria, B. C.

To the Editor of the SCIENTIFIC AMERICAN:

To say the least, a statement where the Einstein judges went wrong looks cheeky, particularly coming from one who has no pretensions toward scientific attainments. But be it remembered that we are of that great body of plebeians for whose especial information the Prize Essay, under the terms of the contest, was written. And none but those of the uninstructed multitude can properly say whether this essay has failed of its mark or not The scientists, as judges, may conclude that the claimant for the prize has satisfied his case, but it remains for the common jury to record the verdict The writer therefore considers that he is privileged to pass humble criticism upon this matter *from the viewpoint of the layman* "Laymen can always benefit experts by suggestions, if in no other way," says Mr F J. Clarke in "Self-culture," and it is believed that not only laymen but the expert also will concede the truth of what is set out below

This apparently cheeky letter is in one way a compliment to the Einstein judges, for the submission is that they know too much So well versed apparently are they in the ideas connoted by scientific terms that they have failed to realize there could be any so hopelessly uninformed as unable to appreciate in all particulars, what the prize essayist was talking about When this essay appeared the writer commenced to read it with avidity, for he was anxious to know what the Einstein theory means, and here, thought he, will be found, couched in plain English and surrounded by no ambiguous terms or reasoning, what he is after Alas for our ignorance and, perhaps, our stupidity! Avidity quickly gave place to diffidence, and diffidence to dismay, as the writer realized that, for him, the essay was a sealed book

I entirely agree with the Messrs Parkhurst when, in their letter to the editor of this Review of 5th March last, they say the essay "was a gross miscarriage of common sense under the terms and articles of the contest" Mr Bolton's article meant nothing to me for the simple reason that it contained, at the precise point where clearness of diction and of ideas was essential, terms with which I am entirely unfamiliar and an expression of ideas the impenetrability of which could not and would not yield to all the reasoning my dull and uninformed intellect was able to bring to bear upon the subject These facts should not be lost sight of The paper was absolutely beyond my comprehension, and the whole article was, for me, an egregious failure Fortunately, it is not so now I have read the other essays since reprinted in these columns, and particularly No III by Frank E Law and others, and, in the light of what is therein contained, I am enabled to peruse the Prize Essay with some degree of assurance Let me, however, make this much clear: The comments which *directly* forced perspicacity upon me were not contained in any of the contesting essays, but were those most clear, most useful, and most significant short statements which the Einstein Editor himself interpolated in article No III His dicta appeared neither too soon nor too late, but precisely at the exact point where something was required, and urgently required, for conveying adequate comprehension

Wherefore, the writer is of opinion that the Prize Essay, in so far as it obviously did not comply with the main term of the contest namely, that it should be clear and appreciable to the uninitiated, is a failure, and a marked failure at that As an accurate exposition of the Einstein theory, I, of course attempt no criticism, and have no reason to doubt that the judges selected the essay which most *correctly* interpreted the matter, but they apparently lost sight of the layman, and inasmuch as the essay failed of its primary purpose, so did the judges fail in not recognizing the defect Their error was one of procedure, not one of substance But procedure, in this instance, was of the essence of the contract

And now, Mr. Editor, if there be any who think I may be wrong in my conclusion, and that I am likely enough so far beyond the pale of intellectual capacity as to be unable to appreciate the Einstein theory in the light of any possible interpretation, let me produce the pages of the SCIENTIFIC AMERICAN in proof of my statement Why was it thought *necessary* or *useful* to further elaborate the theory, as was done in Article No. III, above referred to? And why was it still necessary to go outside even the essays submitted in such further elaboration? There can surely be but one answer—for the purpose of elucidating for us unsophisticated mortals some important points which apparently the Prize Essay failed to make clear And that, it seems to me, sufficiently bears out my contention

In conclusion, may we ask to see the Messrs Parkhurst's essay? We realize it is impossible for all or nearly all the essays to be reprinted in these columns, but, judging from those gentlemen's criticism of the Prize Essay, we are led to believe that a popular and comprehensible exposition of the subject will be found in their article May we have it?

Duncan, B C C. F DAVIE

To the Editor of the SCIENTIFIC AMERICAN:

Your author in the present case was not one of the three hundred who made the bold charge into the Einstein Essay Contest, neither is he one of the twelve who knoweth all things We did go so far however as to have paper on the typewriter and were wading boldly in when someone passed, looked over our shoulder, and said, "Fools rush in where angels fear to tread"

The advertisement announcing the contest said "Five thousand dollars for the best essay on the Einstein Theory so written that it can be read with profit *by an ordinary intelligent person with no special mathematical training*" Mr. Bolton did not fill the contract Mr Francis disobeyed Rule II of the contest, his essay being full of technicalities Mr Law's essay was the best of the three In it we begin to see daylight If you should print another it may bring us into the full sunshine The first two men evidently forgot they were to write so that the layman could understand Their essays were good from the view of a higher college man Your readers looked for something the "ordinary person could understand" It has not been produced

Would it not have been well, perhaps, to have selected one of the judges from the ordinary ranks? Men skilled in the higher mathematics are prone to think in the higher mathematics As it is true that "we are so earth-bound that it is hard for us to get away from earth-bound habits of thought," so it is true that we find it hard to reverse the process, so that we can make universal things understood by the ordinary man

Pittsburgh, Pa THOS J ARMOUR

To the Editor of the SCIENTIFIC AMERICAN

Whether or not I comprehend the Einstein Theory of Relativity, the reading of the article by Montgomery Francis in the issue of February 19 has settled for me one burning question, the one so often propounded "How old is Ann?"

The answer is fully comprehended by the quantity $\sqrt{(X - x)^2 + (Y - y)^2 + (Z - z)^2 - (CT - ct)^2}$ which is the value, measured along a geodesic, of the space-time sequence or interval between the nativity of Ann and her present location in the same The values of x, y z, and especially t, being resolvable into entirely different quantities according to the observer's frame (of mind) and dependent on the observer's speed (of living) as compared with Ann's speed

This squares absolutely with all general experience and observation, which, although far from being proof (see SCIENTIFIC AMERICAN, February 19, 1921, page 146, line 40 to 46), nevertheless makes it easier to believe

Seriously, there is more meat for me in Mr Francis's article than in the winning essay, for, though the latter seems to be a very able laying down of rules and is undoubtedly perfectly plain to one who understands the subject (it must have been to pull down 5,000 good hard "iron men") to me it is an explanation that does not explain

Barring a missing M or two in the illustration and a quantity C unexplained, I got along very nicely with Mr Francis's article

If you will continue to publish more of the losing essays I hope in time to find out what Mr Bolton was talking about J. M. DOCKSTADER

Woodbridge, N J.

To the Editor of the SCIENTIFIC AMERICAN

While I must confess that Mr Bolton's essay on the Einstein theories was not "written down" to my intellectual plane, I wish to compliment the Einstein Editor on his numerous invaluable contributions on this general subject M. JENNINGS.

New York, N Y

WE had intended long before this to give a place on this page to some of the numerous letters we have received in comment on the Einstein Contest. But the Einstein Editor's time has been so fully occupied with the effort to get the book "Relativity and Gravitation" out at the earliest moment that he has not been able to give these letters the careful reading necessary for selection The book is now out of his hands, though publication may be a little delayed by a strike of the bookbinders, and this page is the result We have enough of these letters to fill several more pages, and hope to present some more of them at an early date.—THE EDITOR.

A City Without Water

How Winnipeg Brought the Essential Fluid 100 Miles Across a Barren Plain

By J. F. Springer

THE present city of Winnipeg has a population of perhaps 250,000. This is quite a contrast with 1874 when the figure for population was 5 less than that for the year. In the old days not so long ago, the population was dependent upon local wells for water and upon tanks and barrels carried on carts for the means of distributing what the wells supplied. There was probably never a day in Winnipeg's history until March 26, 1919 that witnessed a satisfactory condition of the water supply. Nevertheless, the city has grown at a fine rate. Even the water obtainable was so hard that it was undesirable for many purposes and practically impossible for others. In short, the city was doomed to severe retardation of its proper industrial development unless a suitable solution of the water problem could be had. However, Dr Agnew nearly forty years ago pointed out an available source of water in the Lake of the Woods. This is a great sheet of water to the east and southeast with an exceedingly complicated shore line. In fact, this body of water is rather an aggregation of lakes and lakelets connected with one another. It is located mainly in the Province of Ontario and the State of Minnesota, and only to a slight extent in the Province of Manitoba in which the city is situated. Dr Agnew's judgment has been abundantly confirmed by careful investigation. The great aqueduct which now connects with Winnipeg takes its supply from Indian Bay, which is an arm of an arm of the Lake of the Woods.

There is a notable phenomenon connected with Indian Bay. Twice each year the waters are overturned. That is, water from below will rise in currents every half year. This is due largely to a scientific fact of much interest. In general, liquids become denser and denser as their temperature falls. Water conforms to this rule except in the interval 32°-39° F. (0°-4° C.). The point of greatest density is 39° F. Whether the water increases in temperature or decreases from this point, it becomes lighter. The effect of the winter on Indian Bay is to cover it with ice, whose thickness may reach 4 feet, and hold the water beneath at a temperature level something above the freezing point. The summer's sun melts the ice and warms up the water at the surface. This water being at a temperature less than 39° will become denser and sink. The water of lower density will rise in consequence. Similarly, upon the approach of quite severe weather, the surface water being above 39°, will upon cooling become denser and sink. The upward currents are accordingly repeated. This fluctuation above and below the critical temperature of 39° results in solid material such as grass and leaves being brought up. So much of such material was brought up upon an overturn in the first year of service that the screen at the intake of the aqueduct was overloaded and damaged. Through the breaks, dirty water and fish found their way into the aqueduct itself. And all this is traceable to the peculiar behavior of water below the critical point.

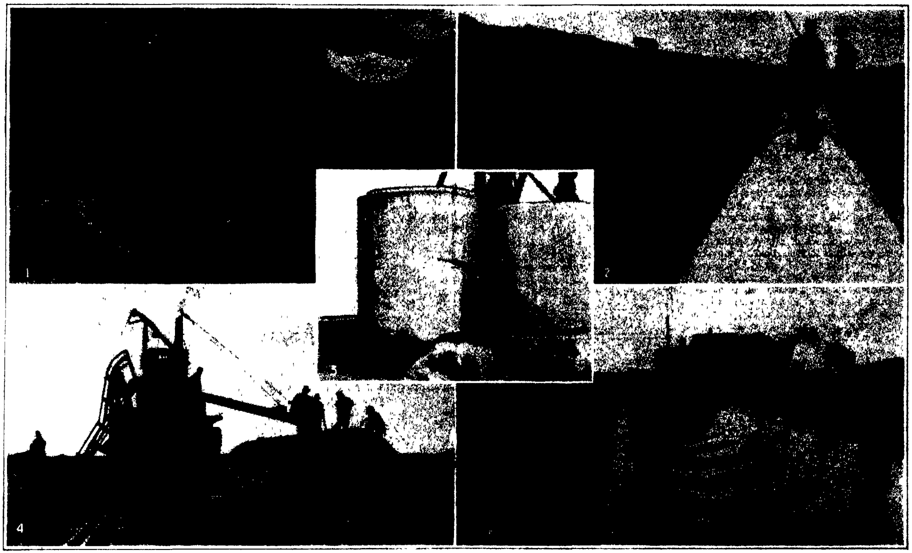
Another interesting matter connected with the source of supply concerns the measures taken to avoid discolored water. In general, the bays which fringe the Lake of the Woods and contribute to it are highly discolored. The reason is that they receive water entering by small streams which flow through swamps and muskegs and bring along all kinds of material. Indian Bay was no exception, its waters having been everywhere burdened with the coloring matter. But Shoal Lake into which Indian Bay empties is comparatively free from discoloration. This is attributed to the effects of time and sunlight. As the dirty water of Falcon River and Snake Lake was mainly responsible for the discolored condition of Indian Bay, the water of the latter could be made suitable if the incoming dirty water mentioned could be diverted into Snowshoe Bay, a nearby arm of Shoal Lake. There was another alternative which would accomplish the purpose by taking the water from Shoal Lake itself. But the former was carried out by constructing a dyke at the west end of Indian Bay and a canal to connect with Snowshoe Bay at a cost of about $147,000. The alternative would have required a 5-mile extension of the aqueduct and a cost of about $1,000,000. The effect of the method actually adopted is indicated by great differences in color of water samples taken on the same day from the two sides of the dyke.

The temperature of the water at the two ends of the aqueduct is just about the same. This statement holds good throughout the year. This is remarkable. The winters are severe in Manitoba, freezing temperature penetrating the ground to a known maximum of 9 feet. "In fact, in Winnipeg, small service mains freeze sometimes in June and July, at that depth." Nevertheless, the cold from the air, penetrating down through the four feet of cover and through the arch of the aqueduct, is unable quite to balance the upcoming heat from the bosom of the earth. The water remains, consequently, at just about the same temperature.

The aqueduct is around 100 miles long, being of about the same length as the Catskill Aqueduct. It traverses a district that is monotonously flat and only infrequently interrupted by water courses. There is a great contrast between the two structures.

For the first nine miles out from Indian Bay, the aqueduct is laid in a cut having two slopes, both very gentle. The gentler of the two is next the bay. Naturally, a larger section of the aqueduct bore would be used here in order to pass the full 102,000,000 gallons per

(*Continued on page 358*)



1 Mold, with reinforcing in place, for the "invert". 2 Backfilling the completed aqueduct. 3. Pre-cast sections for the tubular part of the aqueduct. 4. Delivering concrete to the arch portions of the job 5 Cradles for the tubular sections

The aqueduct that brings water from Lake of the Woods to Winnipeg over a hundred-mile route

From Cruiser to Tramp

IN the effort to add to the world's depleted fleets of commercial vessels, several nations have taken old warships in hand and have transformed them into merchant ships. In this country the cruiser "Boston," of the famous "White Squadron" was thus changed; the French have done the same thing with the "Dupuy de Lome"; the British transformed a veritable fleet of their smaller extemporised warcraft into merchant ships, and now the Germans have tried to make a serviceable merchant vessel out of the old protected cruiser "Gefion." The ship, before and after, is shown here in two photographs.

The "Gefion," built in 1898, was a small protected cruiser of 3,750 tons' displacement. She was 325 feet in length on the waterline, with a beam of 42½ feet and a maximum draft of 21¼ feet. She had a protective deck at the waterline, covering the vital parts of the ship, and her armament consisted of ten 4-inch guns, six 4-pounders, several machine guns and two above-water torpedo tubes Her machinery included two sets of triple-expansion engines, driving two propellers, and steam was furnished by six double-ended cylindrical boilers With 9,000 horsepower she made about 20 knots speed. The two photographs show how greatly changed is the profile of the ship. The curved ram has disappeared; a straight stem takes its place, and the deck and hull structure have been faired out to meet it, thus giving the ship the bow of a typical commercial vessel. The topmasts have been removed; but the steel lower masts stand as they were To secure sufficient deck room and hold space, the three smokestacks and the bridge, together with the guns, ventilators, et cetera, have been removed and a new bridge has been built well astern, with a single smokestack abaft of it The ten 4-inch guns with their gun mounts are gone, and as the boat now rides the water it would take an expert eye to detect that she had once been a warship The position of the present smokestack would suggest that the whole of the original boiler and engine room plant has been removed and new motive power installed in its place

As a rule it is not found to be a paying proposition to attempt to turn warships into merchant vessels, the amount of cargo space in the reconstructed ship being too limited to render such vessels successful freight carriers

The German cruiser "Gefion" as she looked when devoted to warlike uses

Made over into the freighter "Adolf Somerfeld," she would hardly be recognized as the same ship

Mechanical Hired Men

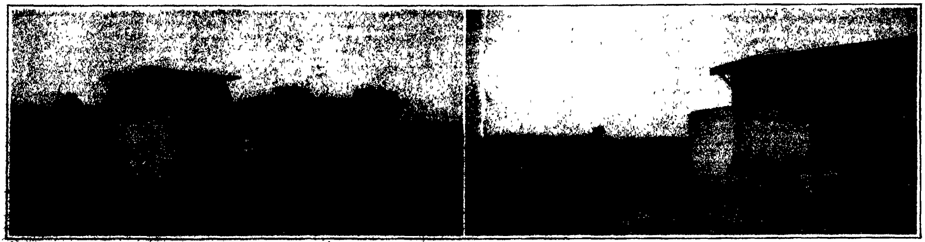
THE mechanical genius of a California rancher is responsible for the inception of the most marvelous mechanical system for feeding live stock in use anywhere in the world. Mr. F. E. Lewis of the Diamond Bar Ranch, Los Angeles County, is producing beef and pork on a large scale on his 8,000-acre agricultural project To simplify the labor involved in feeding the thousands of cattle and hogs which he raises, he is utilizing a novel, miniature railroad system and original inventions in the way of a gasoline locomotive, a special hog-feeding car, extraordinary cattle feeding cars and a unique car developed especially for the whitewashing of farm buildings and disinfecting of the hogs

From a defunct railroad company this successful and progressive rancher purchased an 18-ton steam locomotive and 35 small flat cars as well as 5 miles of standard gage track He so arranged his yards and live stock buildings that space was allowed for the laying of track along all central alleys His hoghouse which is 1,200 feet long and 26 feet wide is the largest in the world It has individual farrowing pens for 250 sows The railroad track passes through the center of this building Mr Lewis has devised a special tank feeding car by placing a 1,000-gallon wooden tank on one of the flat cars He has provided a series of centrifugal paddles in the center of this tank which are kept in motion by a small 5 horsepower steam engine at the front of the car They keep the feed agitated and well stirred The locomotive is operated by a pensioned engineer who is too old for active railroad service The feed is hauled out on the second story platform of the feedhouse and dumped into the top of the tank Simultaneously a 2-inch standpipe sprinkles water over the feed and reduces it to a sloppy consistency The mechanical agitator completes the mixing process The feeding train is then headed at a speed of one mile an hour down the feeding alley One man operates a special lever which opens and closes a 4-inch extendable hose arm at the bottom of the tank which is equipped with a hooded nozzle and which deposits the feed in the individual troughs in the front yard of each hog An automatic gate directly over each of these troughs is operated by another attendant by means of a mechanical trip. As the feed is being deposited in each trough which is outside the individual hog lot the gate is closed and the animal cannot get at the feed When the trough is full, the attendant trips the trigger and the gate swings out at the bottom and rests against the outside wall of the trough and provides room for the hog to insert its snout and eat All these operations are done in the twinkling of an eye as the tank car steams slowly along the alley Mr Lewis is now working on an automatic method of tripping the different gates so as to eliminate the services of one man on the feeding car This method permits of two men feeding 5,000 hogs in 60 minutes, a record which promises to stand for many years

A number of the flat cars are fitted with

(*Continued on page 359*)

The gasoline locomotive and the automatic dump car that make it possible to feed stock by machine



Left: This train, consisting of an 18-ton steam locomotive purchased from a defunct railroad company, and a flat car carrying a 1,000-gallon wooden tank, feeds 5,000 hogs in one hour. Right: A home-made whitewashing and disinfecting equipment. The flat car carries a large wooden tank of 35 barrels capacity and a four-horsepower gasoline engine which furnishes power to run a number of agitator paddles in the interior of the tank, which stir and mix the solution. The engine also operates a triplex spray pump

Two typical trains employed on a large Californian stock farm for doing more work with less labor

With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

Chain Blocks and Trolleys

INCREASED production and economy of labor are the leading factors in present day commercial success, for, as we are coming to learn by degrees, the world is suffering from a steady inflation of production and selling costs rather than from the sole effects of the Great War Had the war not taken place as it did we should have undergone a period of readjustment some five years from now and since the inflation would have attained greater proportions by then the readjustment would have entailed all the more hardships

However, let us come down to specific cases of increased production and economy of labor The lifting and conveying of heavy loads is still being done by antiquated methods in many of our otherwise progressive plants Take the first of the accompanying illustrations for instance Here is a case containing an air compressor, which weighs 1,850 pounds Five men are required to push this case along on the usual hand truck Yet with a chain block and trolley installation, one man can readily handle the same load, thus saving the labor of four men By means of a spur-geared block or even an electric hoist, the load is quickly hoisted into position and held safely suspended With the trolley and overhead I-beam system the load can be quickly delivered to its destination Independent of flooring conditions, up out of the way, the overhead system conserves aisle space, requires less labor and multiplies deliveries many times over other methods

Such an installation is not unduly expensive, yet it repays its cost many times over in a short space of time This instance is but typical of the many labor saving devices which American industrialists must resort to if they are to compete successfully with European industrialists who are working with far less costly labor and who, let it not be overlooked, are daily turning to labor-saving devices in order still further to reduce their production costs

The old and the new way of handling heavy loads in the plant, showing how the labor of four men can be saved

Fighting the Coal Pile Fire

MATERIAL-HANDLING machines are being used to an ever-increasing extent for the handling of coal Indeed, it appears that there is perhaps no better way of operating a coal pile than by the use of one or more of these material-handling machines, with their long power-driven belts that can be installed anywhere and placed at any angle for raising coal from one level to another

Now every user of coal in large quantities knows that this fuel deteriorates if left standing for a protracted period, and that the most practical method of preventing deterioration or even conflagration is to keep the coal stirred up, so to speak In this connection the material-handling machine has a very definite application A typical example of this application is that of the Portland Gas Company of Portland, Maine Two conveyors which they had ordered some time previous, arrived after their storage pile containing 16,000 tons of coal had caught fire By simply turning over the coal, thus giving it a chance to cool, the two conveyors saved most of it, after fire boats playing salt water through twin nozzles into the fire rendered the permanent installation useless

Moving the Sectional Steel Building

IN considering the standardized sectional steel building, stress is seldom laid on the ease with which such a structure can be taken down and transported for the reason that such a feature does not enter into the manufacturer's mind except on rare occasions

An immense sectional steel building, nearly a thousand feet long, was erected by the U S Navy Department at the Ford Shipbuilding Plant, Detroit, Mich This building has now been taken down and shipped to Hampton Roads, Va, where it is being re-erected as three separate buildings—completely conserving the original structure In fact, the ease with which this building and other similar structures have been taken down and re-erected with 100 per cent salvage is a strong point in favor of sectional steel buildings

Hollow Tile and Dry Floors

WITH its non conducting air cells, its density and low absorption value, hollow tile is said to provide an effective insulating blanket for basement floors of factories Hollow tile gives a warm, dry floor, which in turn results in a sanitary basement for the factory or home Moreover, it is economical The large, light units are easily handled and quickly laid First, the ground is leveled so that all ridges, lumps or depressions are eliminated. Then a layer of cinders or broken stone is put down and covered with a thin layer of sand This is all pitched to the floor drains The tile is then placed on the sand cushion so that it is as firm as when imbedded in the mortar joint in wall construction These tile should not rock or teeter when walked upon The surface of the hollow tile floor is thoroughly wetted before laying the cement top coat, which should be composed of one part cement to not over 2½ parts of clean, coarse sand, applied 1 inch to 2 inches thick, depending on conditions

A Telescopic Hoist for All Jobs

FOR the handling of ash barrels and other refuse there is often need for some form of hoist that is available when wanted but out of the way during idle moments Working on the telescopic principle, there has been developed an ingenious hoist which may be used for lowering and raising ash barrels, bags, bales, carboys, parts of machinery and other loads under 1,000 pounds The upright standard of the hoist may be raised or lowered by means of a hand-operated winch, while the cable, traveling up through the hollow standard and swinging arm, is controlled by an electric hoist

Weight of Ash and Various Kinds of Coal

IN taking inventory of fuel stocks, or in estimating sizes of bins for a given quantity of fuel, it is often necessary to know the weight of a given volume of a certain kind of coal The accompanying table which appeared in the *American Contractor*, supplies the needed information in a convenient and concise form

TABLE SHOWING WEIGHTS OF COAL AND ASH

Material	Weight in lbs per cu yard	Volume of 5 tons in cu yards
Ash, clinkers and cinder	1,700	2.85
Coal, anthracite, lump . .	1,875	2.13
Coal, anthracite, broken .	1,782	2.24
Coal, anthracite, egg . .	1,758	2.28
Coal, anthracite, stove .	1,736	2.3
Coal, anthracite, chestnut	1,693	2.4
Coal, anthracite, pea	1,640	2.48
Coal, bituminous	1,500	2.66
Coal, Cumberland	1,450	2.76
Coal, cannel	1,360	2.94

Why Mechanical Stokers Pay

COMBUSTION rates up to 60 or 70 pounds of coal per square foot of grate per hour are now attained in stoker-fired plants, and single stokers with areas of 150 to 200 square feet are now in operation. It is this high combustion rate and large grate area, together with modern ash handling equipment, that has made possible the economical operation at high ratings of the large boilers now becoming common. Ash disposal is one of the important problems to be met in the operation of large units It has been estimated that the ash content of coal burned under boilers in 1920 was from 10 to 20 per cent greater than in previous years, this increased ash causing much difficulty and, in some instances, limiting the boiler output

Better Glass for Daylight Lighting

KNOWING the importance of greater conservation of daylight, research work of a leading wire glass manufacturer has been directed toward the production of glass with high diffusing power Since great areas of the side walls and roof of modern factories are built with steel sash and glass, it has been the aim of this manufacturer to provide a glass that would handle daylight to the best advantage.

The result is in the form of a new wire glass, every square inch of which has 900 prisms that appear like tiny corrugations Their shape and size have been scientifically determined to promote diffusion The United States Government used over 100,000 square feet of this new glass for a single building, and the new glass is attracting much attention wherever it is being introduced

Some Causes of Accidents

A STUDY of the causes of 220,707 accidents which have occurred in the plants of the United States Steel Corporation shows that but 4 94 per cent of the total number, excepting those in connection with overhead electric cranes, were due to machinery causes While no doubt this very low percentage is the result of the protection afforded by the mechanical safeguards installed by the subsidiary companies of the corporation, the accidents represented even by this low percentage do not indicate that the machines were not properly guarded, for employees do get hurt through their own carelessness even though the machines are equipped with safety devices.

Hand labor caused 44.42 per cent or nearly one-half of all these accidents. The conditions under which these accidents occur are almost wholly within the control of the workmen and are due largely to their carelessness. In analyzing the causes of any 100 accidents it will be found that at least 90 of them might easily have been prevented.

Aside from the 44.42 per cent caused by hand labor, the corporation's records indicate 4.94 for machinery, 14.76 per cent for the mines, 4.26 for railroads, 7.18 for burns, 5.10 for eyes, 8.09 for falls, and 11.30 for all other causes.

Bringing the Wood-Burning Locomotive Up to Date

WE are apt to think of wood-burning engines as of the days "before the war" (the Civil War, of course) and, as a matter of fact, they practically disappeared during the late seventies. At the present time a few are running in this country, but they are mostly in lumber camps where coal is not available

The scarcity of coal which has prevailed during recent times has been a serious problem to many railroads far removed from the mining centers, and, in the case of some South American countries, where coal has to be imported, the employment of a substitute fuel has become imperative

The management of the Sao Paulo Railway of Brazil has met the situation by what might appear a step backward, but which is, in reality, a bold and practical solution of the problem

The accompanying illustration shows a remarkably handsome and well designed locomotive now hauling fast passenger trains between Sao Paulo and Rio de Janeiro. It is of the 4-6-2 or "Pacific" type, and the neat appearance and high finish of the engine are strongly suggestive of British practice

There is no outward indication of the engine being a wood burner, except that the tender is stacked high with the necessary fuel The extension smoke box is provided with a spark arrester so that no change in the shape of the smoke stack has been necessary The present writer remembers the enormous "balloon" stacks on our old wood burners The diameter of these stacks sometimes rivaled that of the boiler, and, as their spark catchers were more or less inefficient, they scattered showers of bright sparks on the adjacent land, causing many fires Some old railroad men who were firemen on wood-burning engines in bygone days are still living They affirm that, with small fire boxes and short boilers, these engines blew out much fuel at the stack, which emitted not only sparks but flame, causing the top of the smoke box to become red hot Furthermore, when hauling a heavy train the fireman's job was a laborious one, as the fuel burned away rapidly and the fire box had to be kept literally filled up to the fire door It was often necessary to employ an assistant fireman known as the "wood passer" whose duty it was to carry the wood from the tender and pile it on the deck ready to the fireman's hand

But with a modern locomotive fitted with a water-tube and fire brick arch and a correct proportion of boiler and fire box, there should be no serious waste of fuel; so that the task of firing the Sao Paulo engine under notice is not so laborious as would naturally be expected

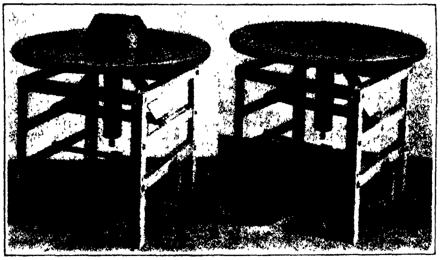
Wood-burning locomotive that hauls fast passenger trains between Rio de Janeiro and Sao Paulo, in Brazil

Measuring the Flowability of Concrete

FOR determining the flowability of concrete or mortar mixtures to a more certain degree than mere estimating by eye, judgment or feel, a device has been perfected by the Bureau of Standards. This consists of a metal-covered table top which can be raised vertically by a cam working at the end of a vertical post. The table top is attached to the top of this vertical post. A bolt at the lower end of the shop regulates the height of the drop.

In measuring flowability of a given mixture of concrete a mass is molded at the center of the table in a sheet-metal mold. The mold has the shape of a hollow frustrum of a cone. By slight tamping the mass completely fills the form and the form is withdrawn. By dropping the table 15 times through a distance of ½ inch the mass is flattened and it is usually found that it spreads concentrically. In making the measurement to compute the flowability two diameters at right angles to each other are measured If the difference is apparent the long and short distances are measured A self-reading caliper is used and it is graduated so that the sum of the two readings is the value for flowability The value may also be calculated by dividing the diameter of the new mass by the diameter of the original mass before agitation and multiplying by 100

This device will accurately measure consistency of a concrete, mortar, cement or lime paste for all consistencies varying from dry masses having a slight tendency to flow or change shape when acted upon by external forces to those which are so fluid that water will flow away from the coarse aggregate



Getting a numerical value for the "flowability" of concrete

The Reinforced Concrete Road

FORTY miles of concrete roadway has been laid recently in experimenting with the use of reinforcing bars The concrete base is reinforced with ⅜-inch deformed square steel bars which are placed transversely on 18-inch centers. For the minimum outlay of steel this size and spacing meet the requirements of maximum bond across the longitudinal cracks if any cracking occurs It has been found that shoulders of roads as narrow as the 15-foot widths which are being laid so widely in California now are worn down quite rapidly Where transverse cracks reach the edge of the road it has been found that triangular sections will ravel out By using a longitudinal run of ⅜-inch bars these points are strengthened These longitudinal rods are laid with the joints alternately butted and lapped and the butt joints are brought half way between the adjacent transverse reinforcing bars

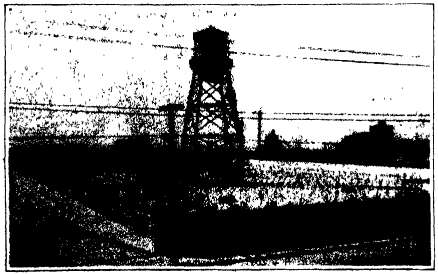
These reinforcing bars are placed in the center of slab and several ways have been tried such as thrusting them down from the top or pulled up from the bottom where they were laid before pouring The most satisfactory method so far used is by supporting the bars at the proper height by short lengths of pipe and the pipe is withdrawn as the concrete is poured On a 15 foot pavement two short sections of 2 inch water pipe for supporting the steel rods at approximately one-third of the distance from each edge are used These sections of pipe are fastened to the concrete mixer by wire or chain and the mixer moving along pulls the pipes also

The longitudinal rods are supported by hooks hung on the headers or by short pieces of 2 by 4 in which a slot is cut which holds the rod at the proper height and distance from the edge of the pavement The wood blocks are moved along as the paving progresses The ends of the transverse rods are bent and hooked over the longitudinal bars and securely wired On wider pavements than the standard it is customary to use four sections of pipe fastened together in a rigid fan shape arrangement so that the rods will be held in position until the concrete is poured

How reinforced bars are being used on the concrete roads of California

Making the Future Floor Serve As Temporary Roof

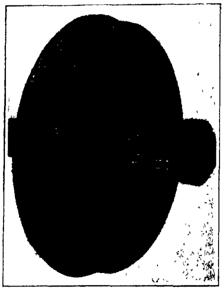
THE construction shown in the accompanying view is typical of what is being done throughout the country under present conditions, namely, building with a view to the future Here is a car barn building one story high with a roof that is to constitute the floor of the second story when traffic requirements warrant the building of a second story It will be noted that this floor will be arranged in the form of pits, permitting workmen to get under the cars, and that the concrete reinforcing rods are arranged in rows to form the pits and track supports In the meantime the concrete has been given a waterproof coating to make the temporary roof impervious to rain



Car barn one story high, with the floor of the future second story serving as the roof

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Applying special roller bearings to the axles of railroad cars

Saving Railroad Power with Roller Bearings

THE high operating costs of our railroads today have undoubtedly prompted an inventor to suggest the use of roller bearings as shown in the accompanying illustration. This special roller bearing attached to the end of the usual car axle, obviously reduces friction to a marked extent. In fact the inventor claims that a train equipped with such roller bearings effects a saving of 50 per cent in the motive power required but this seems to be an extravagant claim. At any rate a car equipped with such roller bearings and representing a load of sixteen tons was pushed along by one man during a recent demonstration. Another advantage of this device is that the axles become self lubricating, avoiding hot box troubles.

Automobile Valve Grinding by Motor

WE illustrate a very convenient motor driven valve-grinder which ought to take a good deal of the trouble out of this troublesome operation. It will be seen that facing the grinding tool, the machine carries a circular chuck with a hole in it. The valve-stem goes through this hole and is held in place by turning the knurled screw on the far end of the chuck, almost hidden from view in the picture. Then by means of the scale on the little table that carries the chuck and a notch on the upper surface of the semi-circular protuberance from the stand the machine is set for any desired angle and will grind the valve accurately to this angle.

A quick, easy and accurate valve-facer

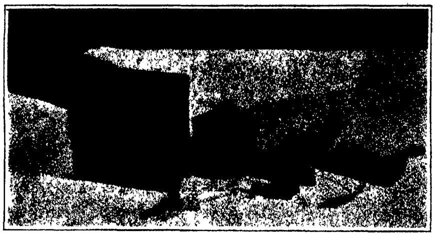
A Radio Receiver for Everybody

FROM France comes the tiny radio receiving set shown in the accompanying illustration. This receiving set consists of a telephone receiver of the watch-case type on the back of which is mounted a multi-contact crystal detector, as well as a collection of accessories.

The diminutive receiver may be connected by means of the flexible leads normally wound on flat spools, to any object that is at all suitable as an aerial, and to a "ground." A fixed condenser, shown at the right, may be connected in parallel or in series with the telephone and detector combination, so as to vary the wave length of the receiving circuit. However, it is well to mention the fact that a simple receiver of this kind operates on a broad wave length; that is to say, it receives signals of all wave lengths within wide limits.

The multi-contact detector, contained in the brass casing on the back of the telephone receiver, is an ingenious device. Ten fine wires press on ten different spots of a galena crystal; and the ten wires are connected to ten contact points of a switch. By turning the switch from one contact to another, a different "spot" is selected, until the best "spot" is found. By unscrewing the brass casing cap and turning the cup containing the galena crystal, ten new "spots" may be brought into play. The tension on the crystal may be varied by turning the brass casing collar.

This simple receiver is especially intended for the reception of time signals by jewelers and others interested in accurate time. Radio stations throughout the world are sending time signals day by day, which may be intercepted over a wide area because of their great power. Such signals are simple and do not require a knowledge of the code.



Copyright, Kadel & Herbert

Complete radio receiving set especially intended for jewelers and others interested in receiving time signals from Government stations

Omnibus Stability

ONE riding as a passenger on the top of one of the double-decked buses used in New York and London may sometimes feel that he occupies a dangerous position should the bus tip over. The chances of this occurring have been analyzed recently in a British publication, *The Engineer*, and the conclusions reached in the article, of which this is a digest, should give the passenger who likes to take the breezes from the top of a bus considerable satisfaction.

Taking the ordinary design of motor omnibus used on the London and New York streets, we find that it is a vehicle weighing, in service condition, some 9,150 pounds, of which weight a little over 64 per cent is in the chassis. It is capable of carrying, without overcrowding, thirty-six people, representing, on the average, a load of 5,400 pounds, so that when fully laden the vehicle and those on it weigh something in the neighborhood of 6½ tons. Its center of gravity, in service condition, but without load, lies low down, being only about 44½ inches above the road surface, or just a little above the level of the tops of the rear wheels. The gage of the wheels being 70 inches, it follows that the vehicle will recover itself if it is tipped up until the rear axle is lying at 39 deg. to the horizontal.

When the omnibus is fully loaded the center of gravity rises to 62 inches above the road surface, so that in this condition the maximum heel from which the vehicle will recover itself is 29½ deg. These figures do not take account of the fact that the body is mounted flexibly on the chassis. In an actual test the yielding of the springs permitted the vehicle to be tipped, when empty, until the center line of the body was inclined at 46 deg. to the verticle. It will be seen, then, that the stability of a motor omnibus empty or fully loaded is considerable when vehicle is stationary.

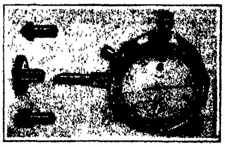
When the omnibus is in motion the angles of heel mentioned above are a measure of its stability so long as its course is a straight line, and indicate the magnitude of the "bump" in the road required to upset the vehicle. Thus the wheels on one side of the omnibus could rise off the road surface nearly 8 feet without entailing the upsetting of the vehicle. Bumps of this description can be ruled out of consideration.

The critical test for the stability of the vehicle arises, of course, when centrifugal force comes into play during the rounding of a corner. Taking 30 feet as the radius of the curve and 7 miles per hour as the speed when rounding the corner—both figures being on the severe side—the upsetting force on the fully loaded omnibus works out at 7,915 lb./ft. The righting moment of the vehicle is 42,430 lb./ft.

A Speed Indicator Combining Stopwatch and Revolution Counter

A NEW YORK manufacturer has developed a device for counting speed over a period of three seconds which integrates the result and gives the information sought in terms of revolutions per minute or yards per minute. The timing, by use of this device, is obtained automatically. After connection has been made with a machine, all that is necessary to obtain a reading is to press a large button. When the contact is made with a shaft the spindle of the instrument runs freely until the button is pressed down and released. The spindle is automatically freed after the device has run three seconds and the hands remain in the reading position. By pushing a small button the hands may be brought back to zero.

The instrument can be operated in any position and has a range from 1 to 10,000 revolutions per minute. The long hand indicates speeds from zero to 1,000 revolutions per minute and the short hand running over a separate dial counts the number of thousands. Either revolutions per minute or yards per minute may be read directly on the dial without requiring any mathematical calculations. Both the large and small dials have a second set of graduations in red to indicate speeds in yards per minute.



Pressing the button gives the reading with this speed counter

Keeping the Trousers in Correct Shape

FROM England comes the simple yet effective idea shown in the accompanying illustration. This device, intended to keep trousers in *a smart condition*, as our English friends put it, is the invention of G. Parnell, an ex service man. It is made of featherweight rust-proof metal, and fits into the cuffs of the trousers, giving them the correct Bond Street set-up over the shoes. This device appears to be a fit companion to other devices of the same category, intended to give a definite shape to soft hats and also to coat collars.

A device which fits into trouser cuffs and gives the trousers the proper shape

American Lignite Coals

(Continued from page 344)

binder will not stand storage and handling. On the other hand, briqueting the untreated lignite with a binder is commercially prohibitive because of the expense involved in view of the low grade of the raw fuel. It was because of this that a system of drying and carbonising had to be developed which would produce a substance lending itself readily to processes of briqueting.

The carbonised lignite is said to bear somewhat the same relation to the original material that charcoal does to wood, and the resultant coke contains about double the amount of fixed carbon that would be found in a like quantity of raw lignite. Therefore, with its combustion value thus improved the coke justifies the price of a suitable binder.

The practice is to mix the carbonized material with a binder and then to subject it to compression in a briqueting machine. In this condition, however, the briquets are not waterproof, and to make them so they are heated sufficiently to cause the binder to coke. The Canadian investigators have spent a good deal of time in fixing upon a suitable binder, because they recognize that this factor would be an important one in making the whole undertaking industrially practicable

Coal-tar pitch is an excellent binder, but that substance is by no means cheap in Canada, and the amount available there is rather limited. Sulfite pitch, produced in the manufacture of paper pulp, is at hand in immense quantities. This liquid is generally discharged as waste into the waters near pulp mills, and has been responsible for the poisoning of the fish in the streams This pitch provides a thoroughly satisfactory binder

The Canadian Research Council sapiently pointed out three years ago, before the Lignite Utilization Board became active, that the road to success in the briqueting problem is strewn with the wrecks of ill-conceived attempts to do this apparently simple thing—failure resulting from either ignorance of what had been done, lack of technical experience, or shortage of money. Therefore, the Lignite Utilization Board obtained the generous appropriations already mentioned, and with this fund in hand, and with a wealth of expert assistance, it was relatively easy to settle upon a proper line of procedure and then to start the erection of a plant of ample capacity to operate on a commercial basis. The Board intends to distribute its output through the ordinary channels of trade even though working as a governmental institution As explained officially, "In its relation toward business interests, the Board has the power of an incorporated company to buy, sell, make contracts, hold property, etc. In its relation to the Government, it is a trust, holding and expending funds provided by the Government; and having power to hold property in trust."

The factory at Bienfait would have been in full swing months back had not delays been encountered in connection with the delivery of machinery and building materials. Even so, the chairman of the Board, Mr. R. A. Ross, reports that the works will be producing briquets by the beginning of the coming summer. This example on the part of our neighbors to the north should prove heartening to us, and no doubt will serve to strengthen the hand of the U. S. Bureau of Mines in its ceaseless endeavors to open up new sources of fuels within our continental limits. Two years ago the Bureau stated that the nation's coal resources of all ranks totaled 3,553,687,000,000 mineable tons of 2,000 pounds, of which 1,061,290,000,000 tons, or nearly one-third, consisted of lignite. Of this lignite 984,424,000,000 tons lie in North and South Dakota and northeastern Montana, while approximately 23,000,000,000 tons are in Texas, 7,404,000,000 tons are in Alaska, and relatively smaller quantities are in several of the other western and southern states. Plainly, if these so-called low-grade fuel deposits can be transformed into briquets substantially the equal of a corresponding weight of anthracite coal, surely this metamorphosis should be encouraged in every possible way

The fact that should be held continually in mind is that our lignite deposits are commonly found in those parts of the country where no other solid fuel exists. The average analyses of some of our lignites give the following values:

		Arkansas	Texas	North Dakota
Moisture	per cent	29.73	28.63	27.13
Volatile hydrocarbons	" "	37 87	32 53	29.11
Fixed carbon	" "	23.95	30 43	36 16
Ash	" "	8 45	8 41	7 60

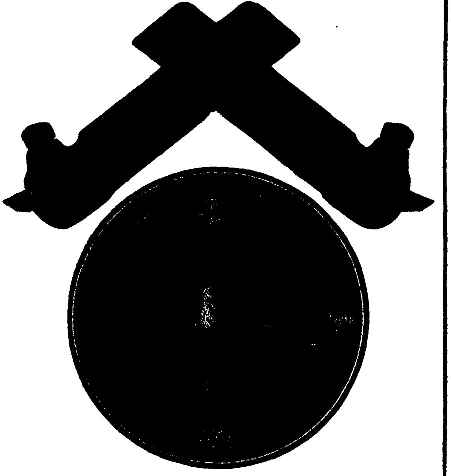
The Alaska lignite closely resembles that of Texas and North Dakota, and the sulfur content of the lignite in these fields rarely exceeds 1 per cent. The average heating value is about 7,500 British thermal units per pound. The Arkansas lignite is distinguished from the others principally by a higher percentage of volatile matter, which yields large quantities of oils and tars

Fuel conditions in so-called western Canada are not radically dissimilar from those prevailing throughout our own lignite-bearing States, into which we ship yearly millions of tons of bituminous and anthracite coals As the Bureau of Mines expresses it, the procedure is "literally an example of 'carrying coals to Newcastle' The results are high prices for both industrial and domestic fuel, the imposition of a great handicap on the industrial development of these regions, the tying up of much transportation equipment needed for other service, and other economic lost motion The problem therefore involved in the utilization of lignite is not a local but a national one."

Finally, by way of emphasis, the Bureau shows what is happening in the territory naturally tributary to the Dakota lignite deposits Into this region something like 2,000,000 tons of bituminous coal is shipped annually from Illinois, Indiana, West Virginia, Kentucky, and Pennsylvania The average haul is about 1,000 miles.

If the lignite in the Dakotas and Minnesota were put into stable and serviceable condition, by means of carbonizing and briqueting, the fuel demand could be supplied with an average haul of less than 400 miles. Two years ago the freight rate was about four mills per ton-mile On the face of it, if the fuel and power requirements of the area in question were supplied from the local lignite mines there would be a yearly saving on freight alone of quite $4,800,000! And if this near-by fuel were used in place of the anthracite and bituminous coals brought from other States, the movement of 1,200 engines and 50,000 cars would be avoided. The rail tonnage referred to does not, of course, include the carriage of 1,500,000 tons of anthracite which makes a goodly part of the trip to this region by way of the Great Lakes

The Bureau of Mines has at its disposal an appropriation of $100,000 for the investigation of lignite utilization, and New Salem, North Dakota, has been selected for the site of a Government plant for large-scale carbonizing and briqueting tests. This allowance seems inadequate in view of what Canada has done to provide for the needs of a far-less densely populated section. Here in the United States the transportation of coal and its widespread distribution invite reflexes of a grave economic character concerning probably twelve times as many people as in the case of the Dominion.



ECONOMICAL PRODUCTION

ECONOMICAL production is, perforce, the objective of the manufacturer, for on it depends, ultimately, his ability to meet the insistent demand for lower prices.

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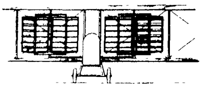
Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AERIAL AND MARINE PROPULSION —W A HEILEMANN and G H SUMNER, Hicksville N Y This invention relates particularly to a propeller of the combined airplane and helicopter type The purpose is to provide a propeller which is designed to lift an airplane or other vehicle to which it is applied during a portion *of its movement, and to propel it forwardly* during another portion of its movement, and to produce a propeller which is capable of driving an airplane at greater speed with less expenditure of motive power than is usual

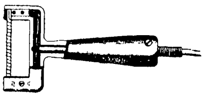


A FRAGMENTARY FRONT ELEVATION OF AIRPLANE WITH INVENTION APPLIED

Electrical Devices

ELECTRIC LIQUID HEATER B W MACY, 400 E Bay St, Jacksonville Fla The object of this invention is to provide mechanism of the character specified capable of heating liquid quickly to a very high degree wherein a heating coil is provided embedded in an agent capable of being heated to a high degree in a short time by the current through the coil

ELECTRIC HAIR SINGER —J P McMAHON 15 11th St Whitestone L I, N Y The object of the invention is to provide a hair singer using an electrically heated wire as the singeing medium to insure a quick and effective singeing of the hair Another object is to provide a simple construction and arrangement to prevent short circulating through the medium of the hair or scalp



A PLAN VIEW OF THE SINGER WITH PARTS BROKEN AWAY

Machines and Mechanical Devices

WIND MOTOR FOR AIR PUMPS —G YANACOPOULOS 621 E 161, New York N Y The invention relates to a power machine which is associated with various other devices in a complete assemblage whereby electrical energy is produced therein Among the objects is to provide a particular form of windmill which may use all of its power in providing a supply of compressed air for a storage tank which is associated with an air engine and a generator whereby it may be utilized to produce electrical current either for immediate use or for charging a storage battery

AUTOMATIC DOUGHNUT MACHINE C A PERDY, 931 Lakeside Place Chicago, Ill An object of the invention is to provide an automatic machine which is adapted to be connected with a suitable prime mover whereby the doughnuts *are formed, dropped into a* container immersed in boiling oil or the like until done and then deposited in a receiving pan without any manual action beyond the placing of the dough in the hopper of the machine

APPARATUS FOR TREATING CINNABAR ORE —A J CARVER, Leland, Oregon More particularly this invention relates to a construction of retort and condenser which cooperate in the recovery of mercury from the ore, an object being to provide an apparatus of the character stated, which facilitates the recovery of the mercury or other material and which economically performs the operation A further object is to provide means for heating the ore while in a finely divided state

COMBINED PRESSURE REGULATING AND GOVERNING APPARATUS —J. P METZGER, Carlstadt, N J This inventor has been granted three patents of a similar nature, the object being to provide an automatic pressure regulating and governing apparatus arranged to insure the accurate functioning of the apparatus as a regulator and after it has been set to a predetermined pressure, and to provide a governing function for coordinating or subcontrolling the regulator without interfering with the accuracy thereof in the performance of its work as a regulator Another object is to render the apparatus exceedingly sensitive and dispensing entirely with packings glands stuffing boxes *and other devices producing* frictional resistance A further object is to provide a combined pressure regulating and governing apparatus arranged to act as an automatic pressure regulating valve or as an automatic stop valve or as an emergency stop valve

BOBBIN UNWINDING ATTACHMENT FOR SEWING MACHINES —L M MENZL, cor Riker and Steinway Ave, Steinway Long Island City N Y The invention has particular reference to bobbin winding and unwinding devices Among the objects is to provide a means or attachment for the bobbin winding spindle adapting the same to receive any convenient empty spool upon which the thread may be readily wound mechanically by operation of the machine

COMBINED MOTION PICTURE CAMERA AND PROJECTOR —F MLADINICH and A. R DE TARTAS, Rockville Center, N Y Among the objects of the invention is to provide a *combined* photographic camera and moving picture projecting apparatus of such nature as to adapt it for ready and satisfactory use by *an amateur Another object is to provide* such a camera suitable to be carried by tourists in place of an ordinary camera, the apparatus being small and adapted to be manipulated for the purpose of photographing animated pictures and suitable with but slight changes for the projection of the pictures at any time after the development of the film

SHEET METAL PRESS —D C CANFIELD, East Canaan Conn The particular object of this invention is to provide a press adapted to form the ends of sheet metal drums cans and receptacles in general, and for properly crimping the same The invention aims to provide mechanism in which the receptacle will be firmly held in position and be operated upon to crimp or otherwise form the end of the same

SLICING MACHINE —A G ALBERTI and A B BARON, 2 Quai de la Rapee, Paris, France The invention has for its object a machine adapted for cutting ordinary meat *sausage, ham etc, into slices of determined* thickness The machine is essentially characterized by a frame carrying a circular knife, the to and *fro motion of which produces the* rotation of the knife and determines the forward movement of the carriage carrying the product to be cut

SICKLE GRINDER —L V SONNER, R F D No 1, Buhe Idaho The purpose of the invention is the provision of a grinder having simple means for rigidly supporting the sickle blade in convenient position, and driving means *for a grinding element* which permits of the universal movement so that it can be moved to any desired position with respect to the sickle blade for effecting the desired grinding of the teeth of the blade

Medical Devices

ORTHODONTIC APPLIANCE — J E JOHNSON, 716 Starks Bldg, Louisville Ky The object of this invention is to provide a device which positively holds and constrains an arch bar to perform its orthodontic function which does not interfere with occlusion and does not discomfort the wearer which is universal in action and application and which is easy and inexpensive to manufacture

DENTAL FLOSS HOLDER —L J HOGARTY, 144 S Oxford St, Brooklyn, N Y The object of the invention is to provide a dental floss holder for professional or personal use, and arranged to enable the user to quickly place a piece of floss in stretched position and allow *of readily removing the* same after use Another object is to permit the ready removal of extraneous matter from between teeth or to apply a ligature *or perform other dental* operations without passing of the fingers into the mouth

Prime Movers and Their Accessories

TIMER —H ZINS, Wabasso, Minn. This invention has for its object to provide mechanism for use in connection with timers of internal combustion engines, for permitting the timer to be arranged above the engine in convenient position for inspection, while at the same time providing the proper drive connection between the timer and the time shaft

PISTON VISE —L A ANDERSON, Box 57, Kasson, Minn The invention relates to devices for holding pistons of internal combustion engines and the like An object is to provide a piston vise by means of which equal pressure is applied to all sides of the piston, thereby holding the latter rigidly without the slightest distortion A further object is to provide a vise by means of which different sizes of pistons may be rigidly clamped

Railways and Their Accessories

LATCHING DEVICE FOR CAR COUPLINGS —T H SANFORD, Alexander City, Ala The invention relates to latching means for effectively securing the draw heads of the couplings together so as to prevent their accidental release and to eliminate the unnecessary slack which is usually found in couplings It is also a purpose to provide a device which in its released position is capable of being moved to a locking position when the two drawheads are moved into engagement

AUTOMATIC RELEASE VALVE — G H SATTLER, 6438 S Honore St, Chicago, Ill An object of the invention is to provide an automatic release valve adapted to be connected to an auxiliary reservoir in an air brake equipment of standard type which will automatically close when the air in the auxiliary reservoir has been exhausted A further object is to provide a device which will normally remain closed, thus preventing escape of air

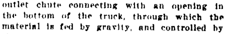
CAR DOOR ACTUATING MECHANISM —W N McCLELLAN, 430 Cumberland St, Brooklyn N Y The invention primarily contemplates a means for controlling the entry and exit of passengers to and from a car said means being operable from a common control point located within convenient reach of the motorman An important feature of the invention is to provide a safety device for reducing the possibility of accidents to a minimum Another object is to provide an efficient fare collecting means which controls the exit passage of the car

Pertaining to Vehicles

TRUCK —R A BRADLEY, Box 102, Merritton, *Ontario, Canada* The particular object of the invention is to provide a truck for conveying crushed stone, coal sand, and other similar material, and to facilitate the unloading thereof by providing on the truck body an outlet chute connecting with an opening in the bottom of the truck, through which the material is fed by gravity, and controlled by the arrangement of a gate

RESILIENT WHEEL —C O PROWSE, 245 W 55th St, New York, N Y This invention has for its object to provide a construction in which the resilient elements are arranged to be brought under tension when the wheel is rotated in either direction A further object is to provide a resilient structure for a wheel with protecting means so that dirt and dust will not interfere with the proper operation of the respective parts

LOW PRESSURE ALARM FOR PNEUMATIC TIRES —W A HARRIS, 238 John St, Greenville, S C The prime object of the invention is to provide a device readily attachable to the valve tube of a pneumatic tire and operable to sound a signal upon fall of pressure *a predetermined number of* pounds below the pressure within the tire when the alarm is connected therewith The alarm embodies an audible as well as a visible signal, the device is protected against dirt, water or the like

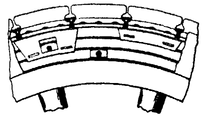


A VERTICAL SECTION SHOWING THE ALARM IN SIGNALING POSITION

COMBINED AUTOMOBILE BUMPER AND TOOL CARRIER —J H DWORK, 217 W. Kenny St, Newark, N. J. The purpose of this invention is to provide a bumper of simple construction which is adjustable laterally to permit its application to automobiles having chassis of various widths and so designed as to support a receptacle in which tools or the like may be carried, such receptacle being formed to allow of the lateral adjustment

TIRE FILLER —V CUTTITTA, c/o Janitor, 325 W 47th St, New York, N Y The invention relates to cushion tires for wheels of automobiles, bicycles, airplanes and other similar vehicles The object is to provide a filler adapted to fit into the shoe of a tire in lieu of an inner inflated tube and arranged to provide the desired cushioning effect, the proportions of the ingredients being varied according *to the particular use made of the tire* A composition of about the following proportions have been found best suited: Para rubber, 56 lbs whiting, 27 lbs., lithage, 13 lbs; sulfur, 3 lbs, ammoniac carbonate, 1¼ lbs, coal tar, 1¼ lbs.

CUSHION TIRE —J C BUSCHE, 318 Hastings St, Detroit, Mich The object of this invention is to provide a tire having the resiliency of a pneumatic tire without its liability to injure, wherein the tread of the tire is composed of spaced connected tread blocks which are mounted to yield toward and from the hub



DETAIL OF A PORTION OF THE WHEEL

AUXILIARY AUTOMATIC SEAT —R H DIETRICH and T L HIBBARD, c/o Le Baron, 2 Columbus Circle, New York, N Y Among the objects of the invention is to provide an auxiliary seat arranged to permit of conveniently moving it into extended position for use or folding it into compact form and storing it in a comparatively small storage space in the front seat of the vehicle

AUTOMOBILE HOOD FASTENER — A SMITH, address Asa E Reed, Hadsell Bros, Worcester, N Y. An object of the invention is to provide a construction of spring catch and mounting therefor, which can be moved to unlocking position and held in such position until released and then elastically spring into locking position A further object is to provide a device which will be simple, strong and durable in use

TRANSMISSION LOCK FOR AUTOMOBILES —J S MICHAEL, *Aberdeen, Md* The invention relates more particularly to a simple, convenient and efficient mechanism which will involve minimum change in and addition to the conventional automobile transmission and which will automatically act by a simple movement of the gear shaft lever beyond one of its normal limits of movement in such a way as to lock the propeller shaft or as to prevent towing of the vehicle and at the same time permit the engine to be started and freely operated without danger of stripping of gears.

Designs

DESIGN FOR AN AUTOMOBILE BODY.—A. DE VELASCO, 1 W 84th St., New York, N Y.

DESIGN FOR A TOILET BOX —J ROSENFIELD, 225 Hooper St, Brooklyn, N Y

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Recruits for the World's Biggest Fish Show

(Continued from page 345)

such a very human look that visitors go into peals of laughter when they witness his antics. Then there is the mud puppy, a dog of the deep. With a set of curious hind legs to match those up in his bow, this specimen might pass as a marine version of the dachshund.

The crew of the "Seahorse" have also been fortunate in securing some good specimens of that curious marine dweller, now rather rare, known as the seahorse Really it looks more like an interrogation point than a genuine equine In very olden days, folks believed in the existence of a seahorse of tremendous size, and artists with active imaginations made pictures of him, snorting on the waves This little fellow is all that is left of him Something in the pose of his head suggests that seahorses once wore checkreins

One of the most vital needs of an aquarium such as New York's is proper apparatus for procuring its living exhibits, as dealers in live animals offer nothing suitable for such an institution The interest and value of its exhibits depend entirely upon its success in capturing and transporting specimens in good condition The method employed in transporting is quite as important as that employed in capture, since specimens must arrive in such condition as will insure their survival in captivity. In the transportation of fresh-water stock, the rough treatment involved in the use of shipping tanks, wagons and trains, is unavoidable, but in the case of marine stock, better methods are now available.

The director of the Aquarium has always felt that a boat with a water compartment has been urgently needed for this purpose, and has often urged its purchase A public aquarium without a collecting boat is in about the same situation as a farmer would be without a wagon

It was not until recently, however that the Executive Committee of the Zoölogical Society finally authorized the construction of a well-boat to be used in making collections of fishes and marine invertebrates for the Aquarium

In making collection of fishes in local waters the Aquarium is not entirely restricted to northern species The Gulf Stream, that great river of the ocean, brings north every summer a host of tropical fishes, some of which have been recently brought in by the "Seahorse" The collecting field, since the installation of the boat, has been extended to such a degree and the work facilitated to such an extent that the Aquarium will soon be able to secure and exhibit something never accomplished heretofore, the majority of the two hundred or more species of fishes known to frequent the shores of Long Island.

What Happens to Ground Water and Why

(Continued from page 345)

a 30-day test Not including sandy lands, the volume of water necessary to move the moisture the first inch was about the same or slightly less than the requirements for conveying the last inch on a basis of 30-day tests The difference in the percentage of moisture discovered near the bottom and that found near the top of a vertical soil column is cause for inference that more water to the inch is removed for the bottom inches than for the top ones.

The experiments indicated that in the event of flumes being inclined downward water attracted into the soil column appeared, after several days, as free water dripping from the flume, thereby constituting what is technically described as a "capillary siphon." The formation suggests that where a canal is located along a hillside water may be drawn out by capillarity continuously, resulting in the water-logging of land farther down. Topsoil of high capillary power and an impervious subsoil, both sloping downward from a canal at an angle of 15 degrees or more are conditions inviting the water-logging of the land A swift, unexpected change in the slope of the ground would produce a swampy area. The lesson the test would teach is so to locate canals as to avoid a repetition of this condition

Columns of soil encased in specially built flumes, each containing one plate-glass side, were a unit of the equipment used in recording the rate at which moisture travels The word "flume" as applied to these experiments signifies the soil column and its containers, one side and the bottom of each flume being constructed of wood with metal lining. A feature of the government tests was the use of inclined columns. The soil columns employed were 100 square inches in cross-sectional area, considerably larger than columns used in previous tests Uniform soil was packed into the flumes and wicks extended from within the water in the tanks up into the flumes, measurements being taken daily and often more frequently.

The flume contained that portion of the soil column extending beyond the outer edge of the ell The bottom and one side were constructed of 2-inch redwood plank, lined with galvanized iron The other side was composed of plate glass, the top of the flume being open or covered with maltoid roofing In area, the soil column and its container was 10 by 10 inches, and of varying lengths The galvanized lining at intervals of one foot was ridged or corrugated with one-fourth inch channels extending up and into the flume The metal lining on the bottom was bent down and over the edge and up on the glass side, constituting a channel for the reception of the edge of the glass side The channel was one-half inch wide and three-quarters inch deep

As to be implied from the name, the ell is an elbow to divert the direction of soil column from the vertical It penetrates six inches within the tank and a few inches within the flume proper This unit was built of galvanized iron, having a cross-sectional area of 100 square inches The bottom end of the ell is closed with a piece of extremely fine meshed brass-wire gauze, soldered thereto The angle is of sufficient amplitude so as to change the direction of the soil column from the vertical upward to any specified range An evaporation tank, 18 inches square and 12 inches deep, was constructed of galvanized iron The tank was placed in a wooden box two inches larger all around than the object which it contained The surplus space was filled with soil, thus insulating the tank upon the bottom and sides Air temperatures were taken with a self-recording thermograph. Both this and the flumes were protected from sun and storm by canvas covers

"Banking" Electricity for Universal Use

(Continued from page 348)

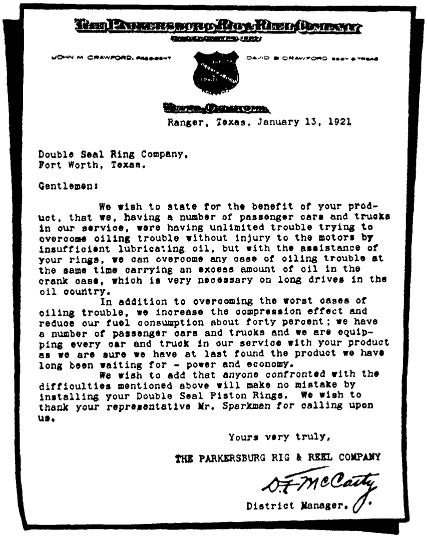
ing the transmission costs per kilowatt hour to 16 per cent of the present

Twenty years ago, in the *American Electrician* for May, 1898, I published an article pointing out that the cheapest form of power storage was a reservoir at the top of a hill, to which water was pumped and the energy of fall utilized Some years later the Westinghouse Company was concerned with a plant for Johannesburg, South Africa, and I suggested this method, and it was used.

But later on a much less expensive and much more simple and efficient and universally applicable method suggested itself. Hills cannot be found everywhere, and as turbine cost decreases and efficiency increases with the height of hydraulic head, hills are not often of sufficient height.

This new method can be used to make not only the big city the receiving and dis

Double Seal Piston Rings



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JOHN M CRAWFORD, PRESIDENT DAVID B CRAWFORD SECY & TREAS

[illegible]

Ranger, Texas, January 13, 1921

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tributing "banks," and the subreceiving and distributing "banks" each a "reception point on top of a hill," but can be applied at practically any point where power is received under the "bank" plan from the general transmission wire or distribution wires So why not make every reception point 'the top of a hill," and with a head of 1,200 or even 2,500 feet? How can this be done? By establishing a 'power bank" at the point The construction of a 'power bank" is very simple Sink a shaft at the reception point 1,260 or 2,500 feet deep, and run lateral headings into it to act as a water reservoir Install a motor, operated from the transmission line running from the gigantic power plants at the coal mines, and connected to a rod pump, and pump the water out of the lower reservoir with the access power not being utilized (or with all the power transmitted) into another reservoir on the surface of the ground (for example, a pond or harbor), and when the power so stored in the "power bank' is needed, utilize it by driving a hydraulic turbo generator located at the bottom of the shaft, all as shown on page 341

Now to figure up the cost of this storage or "bank' plant There are many mines of more than 5,000 feet depth, but we will take 2,500 as perhaps the most economical depth of shaft With a fall of 2,500 feet each cubic yard of water flowing from the upper to the lower reservoir will generate two horsepower hours For a horsepower-hour is 1,980,000 foot-pounds, and a cubic yard of water weighs about 1,700 pounds, and falling 2,500 feet yields 4,250,000 foot-pounds, which is more than twice the 1 980 000 foot-pounds

The costs of such excavation are well known and average about $2 per cubic yard with present methods For example, the Atlantic Mining interests mined and raised in 1902, 446,098 tons of ore at a cost per cubic yard of $1 84 the depth of the mine being 4,250 feet, and the material, quartz This figure is lower than that I give, but even this is not sufficiently low, for mining ore is a much more difficult thing than merely excavating The miner has to follow a narrow vein, and cannot excavate in the most convenient direction and distance Moreover in excavation for a storage "bank," the best location can be picked by preliminary boring and little of the excavation need be through rock.

The volume of the shaft is what might be called dead loss excavation. But this loss is small. In the Tamarack mine, copper and 4,150 feet deep, the size of shaft, for four cages, one ladder and pipe way is 7 feet 2 inches by 27 feet 5 inches Half this would be more than ample for the "power bank" shaft The storage capacity being taken as 1,000,000 horsepower hours, the reservoir excavation would be 500,000 cubic yards, while the shaft excavation totals less than 10,000 cubic yards, *i e*, less than two per cent of the storage capacity

Taking into account the following, *i e*, ability to choose best location geologically and for transportation, etc, lowering of cost due to working along standardized lines and with machinery suited for quantity production of shafts and headings, etc, for a big "power bank" system, I feel sure that the cost per cubic yard of excavation can be brought down to fifty cents As one horsepower is stored for each one half cubic yard, this gives the cost of storage reservoir as twenty-five cents per horsepower hour

That this estimate of 50 cents per cubic yard cannot be much out of the way is shown by the fact that in some of the South African gold mines, it is found that the cost of blasting, excavating, breaking up, raising to surface, pulverizing, leaching etc, amounts to almost exactly 50 cents per ton, or about $1.25 per cubic yard The excavation alone cannot cost more than half that

Since a pond or harbor may be used for the upper reservoir, and since the cost of motor-driven pump plus the turbine-driven generator, for the ordinary transmission system furnishing direct current for street cars, etc., differs very little from the cost of transformers, rotary converters, extra reserve capacity sizes necessary, etc., per horsepower-hour, and may even be less from saving at the generating and equipment, if direct current is used (in some cases even when alternating current is used), we can take the cost of storage plant as 25 cents per horsepower-hour.

Assuming interest at 7 per cent and depreciation at 8 per cent, both of which are high for a plant of this type, since there is very little to deteriorate, we can get cost of storage of one kilowatt-hour for one year, namely, 3 cents.

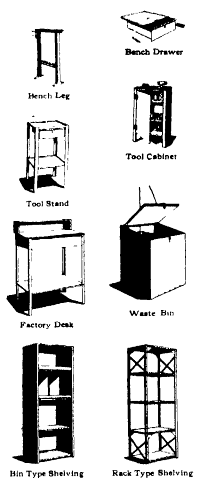
A City Without Water

(*Continued from page 350*)

day, and a smaller section employed on the steeper slope As a matter of fact, however, the larger section was continued for two miles beyond the change of slope. This meant that the depth of water need be only 5 feet instead of 7¼ The result was that all through the 9-mile cut, which was deep and therefore expensive, the level of the invert, as the aqueduct floor is termed, was put about 10 inches higher than would otherwise have been possible The extra cost for the two miles of larger section was not considerable An advantage that may become of value in the very near future, to judge by the rate at which the city grows, consists in the fact that in this, the most expensive, section of the whole 100 miles of aqueduct, there is already a long line of conduit capable of passing 144,000,000 gallons per day A second aqueduct is contemplated, which will carry additional water and will extend from the end of this large construction on to the vicinity of Winnipeg The aqueduct would then be run, at the Indian Bay end, under a small head—from 0 to 4 feet, a booster pumping plant being employed to produce it

The aqueduct from the end of the 9-mile cut follows a route determined principally by the criterion of cost. The land is so flat that topography played only a small part in the settlement of the precise route Foundation costs and grades had to be considered, as they controlled in a large measure the expense It is said that an aqueduct could have been run on almost any straight line connecting Shoal Lake and Winnipeg But, by taking advantage of this condition and that, and modifying the alinement in conformity, a route was determined which effected a saving of some millions of dollars, although as a matter of fact the departures from a perfectly straight line have added several miles to the length.

While the Winnipeg Aqueduct is uniformly a concrete pipe line and does not exhibit quite that multiplicity of construction types presented by the Catskill conduit, still there were problems of importance which had to be solved One of these concerned the foundations It will readily be understood that a route 100 miles long would likely present great variations in connection with the supporting power of the soils encountered. As a matter of fact, the range of variation extended from peat to rock There were soupy clay, waxy clay, various mixtures of sand and clay, granite, trap rock The sand clay mixtures were some of them dry, some wet Since the level of the invert along the aqueduct line was everywhere below ground-water level, two matters were more or less urgent a large part of the time and one of them all the time. The specifications required that the concrete be laid in the dry. This requirement was met by drains and pumps. The second matter, which was urgent at times, was the necessity of providing adequate supporting power. Soupy clay, for example, had to have its resistance to weight increased. This quicksand had to be dealt



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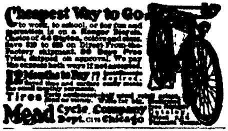

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with, a layer of stone and gravel was put in the bottom of the trench which naturally had to be excavated deeper than would otherwise have been the case, in order to provide the necessary space. Peat beds would be dug out, and sand and gravel, if necessary, put in at the bottom of the trench. Where flowing clay was encountered, the trench was made wider and in some instances a pile foundation put in.

Near the Indian Bay end, the aqueduct parallels Snake Lake for perhaps two miles. It was unsuitable to use a porous foundation in this region and at several other points. The general reason was this. The surface waters stand at higher levels than the aqueduct structure itself

As concrete is not especially heavy, the specific gravity being round 2, and as the bore occupies a large part of the standard cross-section, an empty aqueduct combined with a porous foundation might very well result in actual flotation One cure for this condition is weight Piling on excavated material is a natural solution of the problem; but here the material available for weighting was generally of a peaty character and therefore light in weight. To bring other material to the spot would have been very expensive and to pile up light material to a proper level would have meant a large amount of such material It was eventually decided to put in a very heavy invert This naturally meant expense as the aqueduct is 10¾ feet wide inside Where to use a heavy invert and where not to use it was continually a matter calling for the exercise of just judgment That success has been attained is suggested by the fact that, after a year's operation and with the conduit frequently with a very moderate amount of water in it, the structure remains secure in its place, despite the fact that it has been continually altogether submerged

The aqueduct is of concrete throughout. But in the Red River Valley there is a siphon. This is of concrete, but the conduit is here under pressure. The pipe is reinforced and the concrete itself is especially rich in cement The easterly section, four miles long, of this great siphon is an 8-foot pipe with an 8-inch wall

It was entirely built on the premises, an invert being first poured and then the superstructure The backfill over this pipe is 6 feet deep, being considerably deeper than normal. The reason centers on the prevention of a freezing temperature inside the conduit. This prevention is considered more than ordinarily desirable because the entire circuit of the inner surface is wet; whereas, with the standard section of the aqueduct, the upper part within is never wet by the flowing water.

The section of aqueduct between Red River margin and the site selected for the reservoir some 10 or 11 miles from Winnipeg is also a pipe line of circular section. It was constructed, however, of pre-cast sections 8 feet long. These sections are 5½ feet in diameter and have an 8-inch wall.

The siphon passes through strata originally laid down beneath sea water They contain, in consequence, a heavy impregnation of sodium, magnesium, calcium and other salts. It would be undesirable, to say the least, to have any long continued reactions between these salts and the reinforced concrete immersed in ground water. A good deal of permanent drainage was therefore provided.

The manufacture of the 6½-foot pipe in 8-foot lengths was serious business. A yard was laid out at a point about a mile north of the line of the aqueduct, where it was convenient to receive steel reinforcement and cement by rail. Eight concrete mixers were installed and produced enough concrete for the manufacture of about 240 lineal feet of conduit per day. The reinforcing mesh is said to have been the heaviest ever made. It came in a 46-inch width and had to be bent to shape on the spot. This was done by using special rolling mills Square section rods twisted were also used as reinforcement. These were likewise bent to shape in the yard Steel forms were employed in the casting of the concrete. Steam could be admitted to and about the forms

The actual crossing of the Red River has been accomplished by the use of cast-iron pipe 5 feet in diameter for the vertical arms of the U and by the construction of a concrete-lined tunnel for the horizontal connection from arm to arm

Mechanical Hired Men

(*Continued from page 351*)

special feed racks. They are shunted directly under the silo chutes or into the hay or grain barns, loaded with feed and hauled into the different cattle lots Each car is arranged so that the cattle can eat directly from the car This eliminates much extra work in handling the feed When the car is empty it is hauled from the cattle lot by the locomotive and replaced by another car loaded with feed All these arrangements were worked out and installed by Mr Lewis They are unique on his ranch and are found on no other farm or ranch in the world.

As an auxiliary to the steam locomotive, Mr Lewis has devised an original gasoline locomotive which he constructed out of an old 60-horsepower automobile engine He has installed this engine on a steel frame and mounted it on four ordinary railroad wheels so that it is adapted for use on a standard gage track It is available as an emergency engine whenever the steam engine is out of commission or when an immediate call must be answered at a time when steam is dead in the larger locomotive This rancher has converted one of the flat cars into an automatic dump car for hauling manure and other farm refuse. The car is equipped with a special rack which can be elevated and dumped mechanically at the will of the operator.

Another flat car has been transformed into a portable disinfecting and whitewashing outfit. A large wooden tank of 35 barrels' capacity has been placed on the car. A 4-horsepower gasoline engine located at the front end of the car furnishes power to run a number of agitator paddles in the interior of the tank which stir and mix the solution The engine also operates a triplex spray pump which is used for sprinkling disinfectant over the hogs or for spraying the hoghouses with either whitewash or disinfectant solution. All these mechanical appliances of home design are practical and efficient and are of great value in minimizing hand labor associated with routine ranch work

Dyspepsia After Six Months

A VERY remarkable case of what is known as "deferred dyspepsia" occurred at the London Zoölogical Gardens last year. A fine specimen of the elephant tortoise was shipped to England, reaching its destination in October just as the chilly weather was beginning. On its journey the tortoise seems to have regaled itself to a considerable extent on the straw in which it was packed Almost as soon as it arrived the tortoise passed into a state of hibernation. The following April the creature took a short walk round on a sunny day but its activities were short lived. Quite soon the tortoise became desperately ill with stomach trouble and it was not long before it died. A post-mortem examination revealed the fact that the animal had died from acute indigestion started by the large amount of straw eaten on its journey to England. During the winter sleep of the creature the disease seems to have been held in abeyance only to develop on fatal lines when the hibernation was at an end.

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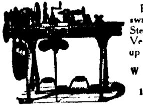

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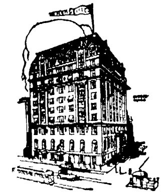

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NEW BOOKS, ETC.

Father Duffy's Story. By Francis P Duffy New York. George H. Doran Company. 8vo., 381 pp.

Over the top with his men!—that was one way in which this chaplain endeared himself to the boys of the Fighting Sixty Ninth. His innate sympathy quickening his gaze, Father Duffy sees through the war toughened exteriors, straight to the heart; the story may in fact be said to embody the humor that in men of courage lightens the most miserable environment and the different expressions of that courage in the high adventures of war. Father Duffy does not need to wear his three medals; the memory of his cheerful self-sacrifice will be ever green among those to whom he ministered. An historical appendix by Joyce Kilmer and lists of citations and engagements close an inspiring narrative.

Fundamental Principles of Electric and Magnetic Circuits. By Fred Alan Fish, M.E. in E.E. New York. McGraw-Hill Book Company, 1920. 8vo., 194 pp., illustrated.

Professor Fish's new text for undergraduate students contains many desirable features necessary to introductory study of the principles involved in electric power machinery and transmission. The lessons include electrostatics, sine wave alternating currents, non harmonic waves, and polyphase currents, with the vital points strongly brought out. Without being so deep or so inclusive as a graduate text, it leads naturally to class discussion of more advanced details, and spurs the student to constructive thought.

The Development of Institutions Under Irrigation. With Special Reference to Early Utah Conditions. By George Thomas, A.B., Ph.D. New York. The Macmillan Company, 1920. 8vo., 293 pp. 2 illustrations.

The Mormons, entering the Great Salt Lake Valley, were confronted by the necessity for irrigation on a large scale. Individual effort was of limited use, and Professor Thomas's absorbing story deals chiefly with the way in which they developed institutions to deal with the situation. He permits original sources to recount their own experiences, and successes and failures are impartially chronicled. Valuable lessons are imparted, and the writer's own field work is liberally drawn upon; his treatise may be unreservedly commended to the attention of all students of reclamation.

Logarithmic and Trigonometric Tables. By Earle Raymond Hedrick. New York. The Macmillan Company, 1920. 8vo., 143 pp., illustrated.

The reliability and usefulness of these tables has been strikingly demonstrated since their appearance in 1913. This revised edition contains much new material. Attention may be directed to the extended treatment of hyperbolic functions, which progress in electrical engineering has made increasingly important. The demands of navigation have been recognized in the table of haversines, while business and insurance will be benefited by several tabulations involving compound interest, annuities, depreciation, etc.

The Chicago Daily News Almanac and Year-Book 1920. Edited by James Langland, M.A. Chicago. The Chicago Daily News Company. 8vo., 1023 pp., illustrated.

If there is anything you would ask about Chicago the last 200 pages of this splendid Year Book probably hold the answer. The other three fourths of the space teems with facts and figures of every conceivable activity within our own country as well as with world wide interests. Politics, industry, aviation, war history, government, finance, social and educational affairs, each has been put through the separator until the cream of the matter emerges. Science is well represented; the astronomical section with its charts and tables is very thorough. The Peace Conference and the League are given much space, and the Covenant appears in full.

The Practice of Lubrication. By T. C. Thomsen, B.Sc. New York and London. McGraw-Hill Book Company, 1920. 8vo., 607 pp., illustrated.

A lubricating engineer who has been responsibly connected with large oil firms has put the lore of his experience into this volume. It is an engineering treatise on the origin, nature, and testing of lubricants, their selection, application and use. Lubrication is rapidly becoming a science, and the lubricating engineer is coming into his kingdom. He will find this book an open sesame to the knowledge demanded of the new profession, enabling him to coöperate with the laboratory, to judge a plant's mechanical and operating conditions, and to recommend the right grade of oil. Firms must establish an adequate technical service and modern sales methods, and must sell experience and knowledge with their oils. Engineers, engine builders, manufacturers and the consumer will all benefit largely by the treatise.

A Text-Book of Organic Chemistry. By E. De Barry Barnett, B.Sc. Philadelphia: P. Blakiston's Son and Company, 1920. 8vo., 380 pp., 15 illustrations.

This general survey of the more significant classes of organic compounds is a worthy companion volume to the author's "Preparation of Organic Compounds." Into the first chapter are gathered general theories, with a few pointed words on classification, nomenclature and literature. Discussion is under the usual divisions of aliphatic and aromatic compounds, and stresses group reactions over the reactions of individual compounds.

Manual of Tropical and Subtropical Fruits. By Wilson Popenoe. New York. The Macmillan Company, 1920. 8vo.; 474 pp., illustrated.

Those for whom the warmer, more generous soils have a spell like that of the sea for the sailor will revel in the vistas opened by this book. The coconut, banana, pineapple, olive and fig have long been remuneratively exploited, and are omitted from this account, but rich prospects remain practically unworked. Traveling as explorer for the Department of Agriculture, Mr. Popenoe's opportunities for observation have been exceptional. In the first work of its kind in English, he provides us with a fund of knowledge—botanical, historical, and cultural—dealing with the nourishing avocado, the fragrant mango, the delicious annonas, the loquat, cousin of the apple and the pear, and so through a tantalizing list that should tempt far seeing pioneers to develop these palatable foods and bring them to the door of the consumer.

Elgie's Weather Book. For the General Reader. By Joseph H. Elgie. New York. Wireless Press Inc., 1920. 12mo.; 251 pp., illustrated.

A nature lover here treats of weather in a familiar, colorful way. It is the romance of changing tints, striking sunsets, and storm magic. But with this poetic outlook is combined the more scientific aspects; reading the weather map is made an agreeable occupation, halos are explained, and the behavior of our animal weather prophets is delightfully chronicled. Artistic photographs, original drawings, and a full vocabulary complete the attractive work.

Currencies After the War. Compiled under the auspices of the International Secretariat of the League of Nations. London. Harrison and Sons, Ltd. 8vo., 254 pp.

Disorganized currencies mean difficult economic problems, and the International Secretariat performs a distinct service in placing this survey of conditions in various countries before thoughtful readers. The immediate purpose of the survey was to give the Assembly of the League dependable material as a basis for discussion. Financiers and economists of different nationalities have given generously of their time; the result is an objective statement of facts on which to base future policy, and government officials and financiers cannot afford to overlook the wide knowledge thus placed at their disposal.

High Frequency Apparatus. By Thomas Stanley Curtis. New York. Norman W. Henley Publishing Company, 1920. 12mo., 269 pp., illustrated.

Revised and enlarged, this treatise on design, construction and practical application makes a strong appeal to engineers, electricians, physicians, students and experimenters. The principles of the transformer, condenser, spark gap, and oscillation transformer are set forth, and the construction of small and large outfits detailed. A section is devoted to electro therapeutic and X ray apparatus, and another to apparatus for the cultivation of plants and vegetables.

England Blue Guide. Edited by Findlay Muirhead, M.A., F.R.G.S. New York and London. The Macmillan Company, 1920. 8vo., illustrated.

Before the war, Professor Muirhead wrote Baedeker's "Great Britain," an almost perfect travelers' guide. The Scientific American of November 2, 1918, revealed how the Baedeker series was clandestinely used by Germany in acquiring information for the General Staff, thus discrediting the books for American and English use. We are glad to see this new guide by the same qualified compiler; it is on the whole a most satisfactory achievement. If now and again the maps are slightly inferior to Baedeker's, the "Practical Information," which even includes aviation passenger routes and rates, can scarcely be improved upon, while much more detailed attention is given to literary shrines, and the descriptions of cathedrals and abbeys are accompanied by admirable plans. Prof. G. Baldwin Brown's "Introduction to the study of English Monuments" is a noteworthy contribution. The routes given by the Blue Guide are excellent, but do not embrace Wales or Scotland, an omission we trust may be corrected by a small, inexpensive supplementary volume.

Gypsum Deposits of the United States. By R. W. Stone and others. Washington: Government Printing Office, 1920. 8vo; 326 pp.; illustrated.

This report supersedes the Geological Survey's Bulletin No. 223 of the same title. In fourteen years, output has increased 300 per cent. Analyses, production, imports and technology are presented, and the various deposits are mapped and described at great length.

The Grand Strategy of Evolution. By William Patton, Ph.D. Boston: Richard G. Badger, 1920. 8vo.; 430 pp.

From close observation of nature's processes Professor Patten seeks to form a conception of "rightness" acceptable to all who follow his thought. He cites the philosophy of war, to condemn it; he minutely scrutinizes the ethics and morality of evolution, the basic factors in constructive action, and individuality; he passes to nature's system of self administration and self-control, and to the "architonics" of evolution, of mentality, and of social growth. It is a large-visioned, biological philosophy that bears witness to truths which should more strongly influence human conduct.

Lead. Including Lead Pigments and the Desilverization of Lead. By J. A. Smythe, Ph.D., D.Sc. New York: Isaac Pitman and Sons. 12mo.; 120 pp., illustrated.

This little volume of the Common Commodities and Industries series straightforwardly outlines processes used, from the uncovering of the ore to the marketing of the metal and the pigments derived from it. Smelting, purification, and conversion into red and white lead are closely followed, furnace methods are sketched, and the historical and human aspects of the subject are emphasized in the plainest of language.

Hand Book of Natural Gas. By Henry P. Westcott. Erie, Pa.: Metric Metal Works, 1920. 8vo., 725 pp.; illustrated.

A more compact and complete body of information, in one handy volume, could scarcely be asked for. This third edition eliminates some obsolete material, corrects a few errors that crept into former editions, and takes up not a few entirely new topics. Geology, properties, field work, well measurement, pipe lines, distribution, domestic consumption, industrial consumption and instalment, and many other headings appear, including helium and its practical uses. From whatever angle the reader may be interested in natural gas, this treatise offers him authentic information of the greatest value.

Technique of Practical Drawing. For Teachers, Students and Professional Artists. By Edward S. Pilsworth. New York. The Macmillan Company, 1920. 8vo., 150 pp.; 23 plates.

The advertising pages of any magazine will furnish instances of good ideas spoiled by poor technique. Few of the cheaper handbooks on this subject are worth anything, but Mr. Pilsworth gives us an exceptional guide to the production of professional work in pencil, pen and brush. The tools, outlining, shading, and mixed techniques are handled with masterful brevity, modifications due to reproductive processes are taken into consideration, and attractive plates convey their lessons so plainly that the accompanying comments are well-nigh unnecessary.

Clothing. Choice, Care, Cost. By Mary Schenck Woolman, B.S. Philadelphia: J. B. Lippincott Company, 1920. 8vo., 289 pp.

The budget plan is gradually gaining ground among consumers, and a most important item of the list is clothing. Here is a book that thoroughly posts its readers, telling them how to judge the quality of textiles by sight and touch, and how, at reasonable cost, to clothe themselves in tasteful and durable raiment. It acquaints the reader with the values—in money, wear and looks—of staple materials; with care, repair, renovation, laundering and dyeing. While the ultimate consumer will perhaps profit most by Mrs. Woolman's instruction, sales people, buyers and advertisers, extension workers and teachers of home economics may all benefit by putting these facts and suggestions to work.

IN THIS ISSUE:

FUEL CONSERVATION OPINIONS
MACHINE-MADE WINDOW GLASS

SCIENTIFIC AMERICAN

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INDUSTRY · SCIENCE · INVENTION · MECHANICS

17 JUN.19

AMERICA'S GREATEST DAM IN THE MAKING: THE WILSON DAM AT MUSCLE SHOALS.—[See page 364]

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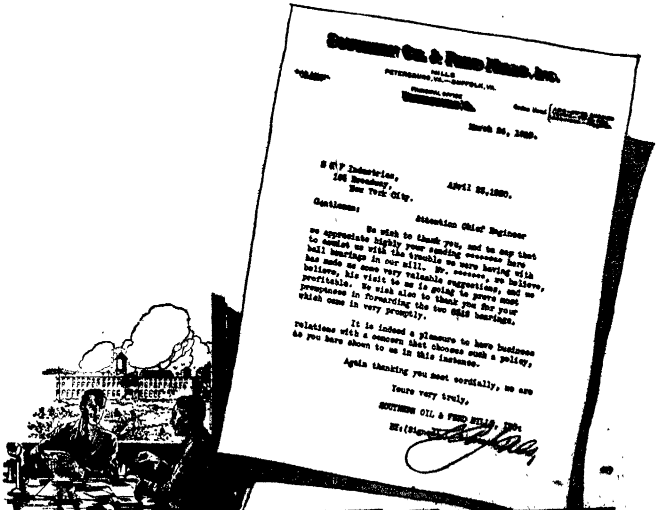

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VOLUME CXXIV. NUMBER 19]
NEW YORK, MAY 7, 1921
[18 CENTS A COPY 20 CENTS IN CANADA

While three or four men are employed in emptying each car, the bulk of the work is done by the operator in the control house shown in the upper right-hand corner

Grain car tilted endwise at an angle of 45 degrees and sideways about 30 degrees. The effect of four unloaders working at once is a bewildering one to the onlooker

Two of the powerful clamps holding the grain car in place, one in the foreground and the other pressing against the lower right-hand corner of the car

Tilting Grain Cars in All Directions to Empty Them

By John Anson Ford

FROM now on a considerable portion of the world's daily bread, as represented by the large quantities of grain that go from Baltimore, Md, to foreign ports, is going to be handled with greater dispatch and economy than ever before, because of the mechanical features which have been incorporated in the Pennsylvania Railway's Northern Central grain elevator in that city Among the outstanding features of this modern structure are four giant electric grain-car unloaders—the first machines of the sort ever built—grain bins with a capacity of 5,000,000 bushels, an unloading pier 900 feet long occupied by six belt conveyors 42 inches wide, ingenious fire alarm and other safety apparatus While the elevator is surpassed in bin capacity by a few others of the most recently constructed elevators, no other has so many novel and remarkable features

The most striking of the equipment features mentioned are the unloading apparatus. There are four of these giant machines, each of which will take a grain car in its grip, tilt it endwise and then sidewise and finally at an angle combining both the endwise and sidewise tilt, until, in the space of five to eight minutes, the car has been emptied. Formerly the best time that could be made in emptying a car of grain—that is, with hand shovelers—was 30 to 45 minutes

With the assistance of a barney or "pusher" the car to be emptied is shoved on to the track of the unloader. Under the direction of a skilled operator, housed aloft in a windowed shelter, powerful clamps rise from below the track level and engage the ends of the car in a vise-like grip. Then a grain-door remover comes into play at the sides Formerly the method has been to hack out this door—an inside grain-tight barrier—with an axe or otherwise break it out These doors now cost about $11 each, and an elevator handling several hundred cars a day is necessarily destroying a good deal of property This new mechanical apparatus is provided with sharp prongs on its inner surface which penetrate the grain door Once securely gripped in this way, the door is pressed inward about 6 inches without being broken This permits the grain to be poured out as the car is tilted The unloader will tilt the car up sidewise to an angle of 30 degrees, and endwise to an angle of 45 degrees The elevator has a receiving capacity of 320 cars per day when all four of the unloaders are working simultaneously

The new Baltimore structure has the greatest grain storage capacity of any on the Atlantic coast Its belt conveyors, bin emptying apparatus and weighing apparatus are so designed that 60,000 bushels an hour can be loaded into one hatchway of a vessel if desired Fourteen belt conveyors carry the grain from the head house to the storage bins and drier

The elevator heads delivering the power by which the grain is carried to the top of the elevator are of novel construction The motors are connected directly with helical cut herring bone gears which effect the reduction in speed for the elevator pulleys with a loss of only two and one half per cent in efficiency, as against a loss of 15 per cent if rope drive were used The flywheel just outside the housing of these gears is so constructed that it serves as a backstop, being provided with an automatic braking device which prevents it reversing its action when the rising grain lifters are for

(*Continued on page 375*)

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The Roger Bacon Manuscript

MANUSCRIPTS from olden time turn up now and again, but seldom has one of these bits of salvage from bygone days been of more real interest or claimed more general attention than the one presented to the world at large in Philadelphia on April 20th and 21st.

This manuscript can safely be pronounced a product of the 13th century. It consists of text and drawings mingled in a way and a proportion which cannot fail to attract the expert eye. The text is plainly a cipher of some sort. The manuscript is accompanied by a letter of presentation from one owner to the next, of the late seventeenth century. So much is certain. The steps by means of which Mr. Wilfrid Voynich, the owner and discoverer, has satisfied himself that the manuscript is from the pen of Roger Bacon, the man born 500 years too soon, require no repetition here; we shall present them in the SCIENTIFIC AMERICAN MONTHLY for June.

Now a cipher manuscript from Roger Bacon, profusely illustrated, ought on its face to be of the utmost importance. There is a good deal of *a priori* possibility that if it could be read it would be found to give an account of scientific knowledge possessed by Bacon which it had been immediate death as a sorcerer for him to impart to his own generation. Professor William R. Newbold of Philadelphia, who has been working on the manuscript for several years, has got far enough to place on public record his conviction that this is precisely what it is.

It must be admitted that one's first impulse on examining the evidence is toward rejection. That impulse we believe does injustice to the case. There can be no doubt that if a scientist in almost any other field were to state conclusions with as little evidence, and this so tenuous and of such doubtful applicability, he would be hooted off the stage and out of the pages of Who's Who. But evidence of the sort that satisfies the mathematician or the physicist is hardly attainable in dealing with a document which has just turned up, and whose past history must necessarily be a good deal of a blank. To authenticate it fully, we should have to establish by independent documents each change of ownership through which it went from Bacon down, with the circumstances of each transfer. If its prior owners were all here to testify it is doubtful that we could do this; certainly with them dead for centuries we cannot do it. All we can hope to do is to show a reasonable sequence through which the manuscript *could* have passed, so as to forestall the claim that it cannot be from Bacon or whatever the source claimed; and Mr. Voynich has done this, and has been particularly successful in showing the possibility of the manuscript's having passed from Oxford to Prag.

Translation of the cipher too opens the door to doubt. Professor Newbold states that this is so difficult and uncertain as to be surely a task for numerous scholars and many years; he doubts that the text will ever be read in its entirety with scientific accuracy. Nevertheless he has read in it at least two statements of fact of which he was ignorant but which have subsequently been verified, one of them being no less obscure a thing than the date of an annular eclipse of the thirteenth century. Again, it is true that the parts of the manuscript so far "read" contain much of mysticism and symbolism so repugnant to modern science that it impresses us as not creditable to a man of Bacon's intellect; but we should be more conservative than this in estimating the degree to which Bacon, with all his abilities, was really able to emancipate himself from the fundamentals of the 13th century in which he lived.

In an early issue we shall give an account of the manuscript, the difficulties of translation, the apparent nature of the text, etc. We believe a fair statement to be that the authenticity of the document as a Baconian cipher, and the accuracy of the interpretation, may be supported without placing their proponents in an untenable position. More than this perhaps we shall never be able to say in any similar case. In any event, the thing is on a basis of respectability which makes it out of the question to classify it with the trivialities or the outright frauds; the very worst verdict we can bring in is the good old Scotch one of "not proved."

Admiral Sims Vindicated

WE have before us a book, "Naval Lessons of the Great War," which we would like to see in the hands of every member of Congress and every citizen who takes an intelligent interest in the Navy. The book is a digest of the four months' hearing held by a Senate committee to investigate the charges made by Admiral Sims that the Naval Administration at Washington was guilty of inexcusable inefficiency, delay, and lack of cooperation with our Allies during the first six months of the war. Admiral Sims made no such charges against the officers and men who fought the war, of whose splendid work he has always spoken in terms of fine appreciation. His charges were directed against Secretary Daniels and the clique of officers that he selected to carry out the policy of apparent indifference to the dire needs of the Allies which characterized the first few months of his war administration.

The value of this book, which was written by Lieutenant Tracy Barrett Kittredge, U.S.N.R.F., formerly on Admiral Sims' staff in London, lies not merely in its revealing how completely the Senate Investigation served to vindicate the Admiral (we all expected that), but in its revelation of the crying need for a reorganization of the Navy, more particularly in respect to giving full authority to the technical advisers upon whom the civilian Secretary must necessarily depend.

So far as Admiral Sims is concerned, the reader lays down this digest of the testimony with an increased admiration for the ability and farsightedness with which he filled his responsible position, and the truly marvelous patience and tact with which he endured, for the sake of the Great Cause, the calculated neglect with which Daniels and his immediate advisers treated their own chosen representative to the Allies.

So far as the Secretary is concerned, the testimony, even of the officers whom he called in rebuttal, served to establish the truth of the Sims criticisms. It shows that from the very outbreak of war in 1914, the fearless and patriotic among the officers of the Navy urged upon our pacifist Secretary the imperative necessity of preparing for war. One by one, these men, beginning with Admiral Fiske, were flouted and forced out of office, so that by the time the war broke, Daniels had gathered around him a staff of such definite color, that its principal member dared to say in the name of the people of the United States that we would as soon fight our Allies as the Germans!

But this sort of thing was utterly foreign to the fine spirit shown by the Navy. As a sample of the attitude of the Navy as a whole, we quote the fact, as brought out in the evidence, that Admiral McKean, on July 20, 1917, *over three months after the war began,* was so stirred up by our failure to cooperate earnestly with the Allies, that he considered it necessary to address a memorandum to the Secretary in which he wrote: "With an earnestness beyond expression, backed by a conviction that has endured from the first, I ask that we meet this great world crisis by contributing our maximum national effort in building, manning and fighting destroyers to drive enemy submarines from the sea. . . . The question of types may rest for the moment *while we make the great decision to do our utmost.* Let it not be said by posterity that we, seeing our duty, hesitated until too late, or that we failed to distinguish essential from incidental effort." And this was one of scores of such communications addressed to the Secretary by officers who could no longer keep silence.

Mr. Kittredge tell us that the officers who fought for sound organization, for naval preparedness, for the placing of the primary emphasis on the naval rather than the civil aspects of the Navy, were forced out of responsible positions. The result was fatal to the spirit and morale of the service. Stagnation or cynical despair often took the place of the old splendid spirit of the Navy.

Mr. Daniels must have realised, before the hearings opened, that if he based his defense upon the facts and the record, he would be beaten. Hence, he turned to personalities, and accused Sims of being pro-British—an attitude which was highly commendable if our heart was with the Allies, but was highly censurable if we would as soon have fought the Allies as the enemy. The Secretary proved to be a tactician—of a sort. When the able cross-examination of Chairman Hale so shortened the range that Mr. Daniels was beginning to be heavily hit by high-explosive shells, he sent up smoke screens in the shape of long statements that had no bearing whatever upon the question. Hence the seemingly immeasurable patience of the Chairman at last gave way, for Senator Hale thus addressed the witness: "My idea was that when we examined you here we would get all the assistance that it was in your power to give. . . . Nobody wants to hide anything or suppress any information. . . . Every question we ask, you come out with a long statement taking up all sorts of other matters, and we never get anywhere."

Altogether, taking it by and large, we are glad that this controversy arose. Admiral Sims struck a brave blow on behalf of the morale of the Navy and got results. The outcome of the matter will be a reorganization of the Navy in certain respects where it is urgently needed. Daniels is gone, and in Secretary Denby we have the type of American that understands the fine spirit of the Navy. As Secretary he has already won the full confidence of its officers and men.

The Yacht "America" to Be Preserved at Annapolis

AS a fitting close to a yachting career which, for variety and vicissitudes, is surely unique, the famous yacht "America," by the courtesy of the Eastern Yacht Club of Boston, has become the property of the Navy Department and will find a permament home at Annapolis. But let no one presume that the schooner "America," as she swings at her moorings in the York River, is literally the yacht that won the cup in 1851. Of the craft which George Steers designed and William H. Brown built in 1850, it is probable that nothing remains except the lines of the midship section and a certain amount of the body.

The "America" sailed the race which made her famous on August 22, 1851. Five days later she was sold by Mr. Stevens to Lord John de Blaquière, who cut down her masts five feet and used her for cruising. In the following year she was bought by Lord Templeton, who sailed her for one season and laid her up at Cowes, in 1854. She was not disturbed until 1859, and when she was hauled out, the boat was almost falling apart from dry rot. She was bought by the owner of a yard near Gravesend, London, who, being a keen sportsman, entirely rebuilt her, thus saving this famous craft for posterity. The following year she was sold again to a Mr. Decie, who renamed her "Camilla."

In the year 1861 she was purchased by some resident of Savannah, Georgia, name unknown, who used her as a blockade runner and dispatch boat. In 1861, the United States gun boat discovered the "America" sunk in the mud of the river, and her captain, later Rear Admiral Stevens, made a gift of her to the Government for the use of the midshipmen at Annapolis.

The next and longest period of her life commenced in 1870, when she was bought by General B. F. Butler, who raced her with more or less success until the year 1880, when she was entirely rebuilt under plans by Edward Burgess, the designer of "Genesta" and "Puritan." Thirty years of improvement in American schooners proved too much for the good old "America," and although in 1885 she was entirely rigged and her stern lengthened, she failed to hold her own with such schooners as "Fortuna" and "Mohican." During the later America Cup races "America" was frequently to be seen under cruising rig.

Electricity

Safety Switches.—There can be no doubting the fact that the introduction of safety switches has resulted in the saving of many lives. These switches, which are made in many different designs, all work on the same general principle, namely, to encase the switch parts and the fuses in such a manner that they cannot be reached except by opening a door, which act automatically disconnects the current from all parts which then become exposed.

Coated Wires and Their Use.—For many technical purposes wires are used in which the central portion and outer coating are made of different metals In the making of electric lamps, for instance, the leading-in wires are sometimes made of a nickel-iron core and a covering of platinum, gold, or copper, the former being so chosen as to have approximately the same coefficient of expansion as that of the platinum or the glass through which the wire is to be sealed In general, however, the expansion coefficients of the core and covering are different.

Maracaibo Radio Station.—Work has been started on the new radio station at Maracaibo, Venezuela This is the second of the three stations whose installation was authorized by the executive decree of June 18, 1920. The Maracaibo station will have a power of 5 kilowatts and the range will extend 500 miles during the day and 1,500 miles during the night The towers will be about 160 feet high, and will be capable of receiving direct daily messages from the Arlington station near Washington, and from the station at Colon The third station is to be erected at San Cristobal

Radio Cable and Radio Compass.—In a recent issue of the *Proceedings* of the Institute of Radio Engineers, R H Marriott, after emphasizing the need for means sufficiently accurate to guide ships through narrow or dangerous channels, or in fogs, urges the installation of signal-carrying conductors under such dangerous waterways Means of indicating to the navigator the proximity and direction of the signal conductor are discussed and experiments described in detail It is suggested that radio compass stations should be used to guide vessels to harbor entrances, where the guide signals could be picked up from a submerged cable and followed into berth

Sweden's Huge Cable.—Twenty-four car loads of underground cable apparatus now on its way to Stockholm, Sweden, is part of a gigantic underground cable system which the Swedish Government intends to install between Stockholm and Goteborg, according to the *Journal* of the A I E E It will be 320 miles long When completed, it will be the largest underground cable line in Europe, and second in the world only to the 450-mile line now operating between Boston and Washington. It will be capable of carrying two hundred conversations simultaneously from Stockholm to its other terminus To complete this big project, it will be necessary to manufacture a total of 425,000,000 conductor feet of cable, 25,000 loading coils and 8 repeater stations with 300 repeaters

Wired Wireless in Germany.—Whereas up till now direct current has been used for telephonic communication, we learn from *The Technical Review* that a new method of producing electrical oscillations makes it possible to carry on a number of alternating current conversations over the same wire Dr. Meissner has been conducting experiments with three-electrode vacuum tubes along this line in Germany The oscillations created by these tubes can be varied according to requirement from 5,000 to 1,000,000 per second. For the human voice only between 10,000 and 50,000 oscillations per second come into consideration. Within this range as many gradations can be introduced as may be necessary for the simultaneous transmission of fifteen conversations over a single wire without causing trouble or inconvenience

A Year's Progress in Radio Telephony.—In connection with research work at the Bureau of Standards on radio telephony, it is necessary to keep in touch with progress in this subject elsewhere. A review of recent developments and achievements has been prepared for publication in the electrical press. The past year has witnessed steady progress and increasing public interest in radio telephony. Voice transmission by radio waves has advanced from the experimental stage to established practice, for distances of a few hundred miles, and since all inherent difficulties have been surmounted, it is actually possible to carry on reliable radio telephony over as great a distance as ordinary wire telephony. It seems probable that commercial telephony across the Atlantic will be an established fact in the not far distant future

Science

Pimento Leaves As a Source of Vanilin.—The Department of Agriculture of Jamaica is continuing experiments in the manufacture of vanilin from pimento leaves. A trial shipment of the oil was made to England a short time ago, and was sold at $2.50 per pound. It contained a higher percentage of eugenol than clove oil Results have shown that it was more profitable for the colony to manufacture vanilin.

Flavian Movies.—The Coliseum in Rome, one of the most valued relics of antiquity in the entire world, has been leased to a moving picture company for a term of years so we may expect more films of gladiators, early Christian martyrs, lions, etc, in the near future The lease of the Italian government is in questionable taste, even for a country in need of every possible source of revenue

Parsley an Absinthe Substitute.—Substitution, particularly in alcohol, is the order of the day and even poor France has her own "moonshine" problem A sudden shortage of parsley, so universally used for cooking and garnishing in France, became apparent It was found that manufacturers were buying it up to make a substitute for absinthe As usual the spurious product is more powerful and deadly than the outlawed green liquor

Congo Paper to the Rescue.—The papyrus of the Congo has shown on analysis to contain 37 8 per cent of cellulose After research and experiments, a process was discovered for bleaching the plants which had been vainly sought for 30 years The American Consul General at Brussels states that it is planned to establish near the river a large plant, costing two and a half million francs, which will have an initial production of 20,000 tons of pulp.

The Airplane Tabooed for Duck Hunting.—Criminal proceedings have been instigated against those in charge of an airplane which crashed into a flock of wild ducks, killing a large number Pictures in a motion picture news-weekly were seen by true game lovers and complaints were sent to Washington with the result that an agent was sent to California, where the incident occurred, with instructions to prosecute for violations of the Migratory Bird Act.

Black Walnut to the Fore.—Black walnut, that wood which was so much in request for furniture in the last century came into its own during the war The uses for this wood were numerous as for airplane propellers, gunstocks, etc, and the nutshells were calcined and used for gas masks The Department of Agriculture is encouraging the planting of black walnut trees everywhere This tree played an essential part in winning the war and a future supply should be encouraged

New Assay Office Open.—On several occasions we have illustrated the operations carried on at the United States Assay Office at New York The new section has just been opened, the entrance being on Wall St The opening was delayed on account of injury to the building by the bomb explosion on September 16th last A vault of five stories entirely below ground serves to contain $5,000,000,000 in gold, if that much bullion should present itself The Secretary of the Treasury has also asked for more bullion storage space in Washington.

107 Uses for the Sweet Potato.—A negro scientist of Tuskegee, Ala, has discovered manifold uses for the sweet potato, that near relation of the peanut, yielding everything from ice cream to ink Mr Carver enlightened the Ways and Means Committee of Congress and incidentally asked for a little "protection" on the products of Southern soil Said Mr Carver, "Here is a bottle of mock oysters Here is a bottle of relish for the oysters, made from peanuts Peanuts make fine cereal coffee. The sweet potato products number 107 up to date I have not finished working with them" So, after all, some of the tariff hearings are not so dull and humdrum as one would think

Mustard Gas Quickly Identified.—According to Lord Haldane, mustard gas was not known in Europe before the war, yet forty-eight hours after it was first used by the Germans, British chemists had run it to earth. It was not discovered by the Germans during the war, as has so often been erroneously stated When Lord Haldane was a student at Göttingen, he often walked round the walls of the university town and noted the chemical laboratory just outside Professor Meier was in charge, and came across the gas many years ago. He recorded the discovery officially, and two British men of science remembered the paper he had written and identified the gas, says the English *Mechanic*.

Naval and Merchant Marine

Storm Warnings by Radio. — The Shipping Board announces that henceforth most of the high power radio stations will send out broadcast storm warnings on schedules furnished to Shipping Board radio operators Ships without radio are directed to ask those which have it to signal weather warnings to them by international code or by any other means that are available.

New High Records at Panama.—The aggregate net tonnage of commercial ships using the Panama Canal in March, 1921, was 1,112,818 tons, as compared with 1,094,323 tons in January, 1921, which was the month of high record previous to March The tolls in March were $1,105,529, as compared with $1,095,857 in January In March of last year, the tolls from commercial traffic amounted to $831,304

The Last of the Centrifugal Gun.—After testing out the centrifugal gun at Aberdeen Proving Ground, the Ordnance Department has decided that because of its great weight and its inability to obtain high initial velocity no centrifugal gun can have military value The centrifugal gun is a perennial This last report is one of several adverse judgments that have been pronounced against it by expert authorities

The Bulge an Effective Protection. — In a recent paper, the Chief Constructor of the British Navy in speaking of the protection afforded by the bulge, said that the cruiser "Hawke", which had no bulge, sank very quickly after being torpedoed As a result, bulge protection was fitted to the other vessels of the class Three of these were subsequently torpedoed and all of them succeeded in reaching port

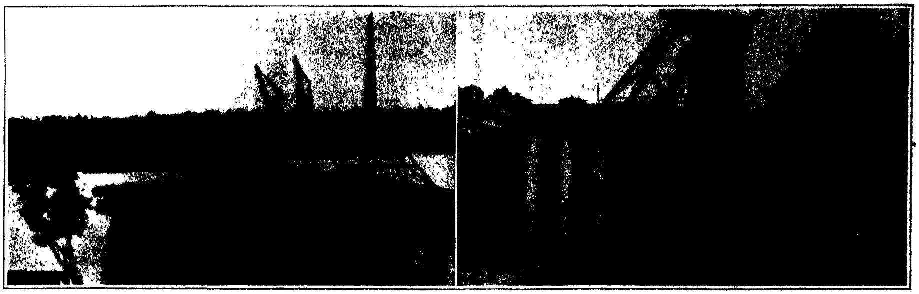
Rebuilding Germany's Merchant Marine.—It is estimated by a representative of our Department of Commerce in Berlin that Germany has today a total of about 665,000 tons of shipping, consisting of 500,000 tons left to her after the Peace Treaty, and about 165 000 tons which she has built since the Armistice This is to be compared with the fleet of 4,935 ships, representing 5,240,000 gross tons which Germany possessed at the outbreak of the war

Organizing Barge Canal Service.—Canal lines operating over 200 modern barges and boats have recently joined the Great Lakes-Hudson and Atlantic Waterways Association, and will agree to establish uniform canal rates, give through bills of lading, and apply ocean transportation facilities to their fleets It is announced that Captain McDugall, the designer of the original "Whaleback," will place five 1500-ton self-propelled barges on the canal this summer

Our Fleet To Be United.—The serious strategical mistake of the Daniels administration of dividing the fleet is to be rectified The probabilities are that three-fourths of the Navy will be concentrated in the Pacific In this connection, we note that the Bureau of Economics at San Francisco calls attention to the fact that the California oil situation will have an important bearing on this matter, and it is suggested that California will greatly assist the matter of oil supplies for the Navy by a further and considerable development of her water power The greater this development, the less will California have to depend upon oil for industrial and municipal purposes

Oil for Coal.—In view of the superior economy of the motor ship to the coal fired steamship, the Munson Steamship Company suggests that it would be advisable to change some of our Shipping Board's vessels to motor ships The suggestion would be good at any other time but this, when Congress is straining every nerve to cut down the national expenditures According to *Marine Engineering*, the amount of oil used in motor ships is only about 40 per cent per shaft horsepower of that used in oil-burning steam installations This comparison indicates that the motor ship will be a paying proposition long after the coal burning or the oil-burning steamship has ceased to run

The German Dreadnaught "Baden" as a Target.—In the course of a paper by the Chief Naval Constructor of the British Navy, read before the Society of Naval Architects of Great Britain, the writer discussed the design of the latest German dreadnaught "Baden," which has recently been used by the British as a target for heavy gun fire He said that, on the whole, the ship showed no superiority in design or construction to British ships, with which statement Commander Land, of the United States Navy, in his subsequent comments on the paper, stated that he was in full agreement Commander Land stated that German construction steel was somewhat superior The "Baden" tests showed that, because of war limitations the latest armor plate as carried by the "Baden" was not so good as the British



Left: A close-up of the work, taken from the north shore, with Jackson's Island and the south abutment in the background. *Right:* A portion of the apron section of the dam masonry in place around the piers of the construction bridge

Details of the work already done on the Muscle Shoals or Wilson Dam

America's Greatest Dam

The Muscle Shoals Project on Which Congressional Economy Is About to Force a Halt

By W. B. West

THIS story of the Muscle Shoals undertaking was written by Mr. West several months ago, at a time when nobody had the slightest idea that work on this great barrage was not to be carried right along to completion. Since that time, Congress in its economy program has refused to appropriate the money necessary to go on with the work, and as a consequence the work will have to stand, as now, 30 per cent completed until funds are again available. There remains to be poured about a million cubic yards of concrete, and at the rate of which work has progressed on the dam this would take only 25 months. The organization of the working staff has been brought to a high condition of efficiency, and for the past few months 4,400 men have been working to unusual effect on the job. Unless immediate provision is made to the contrary, this force will have to be disbanded even before the end of the fiscal year in June, in order to conserve funds for the proper care of the structure pending a resumption of activity. The annual loss in deterioration and in interest on the idle capital represented by the dam will be greater than the annual appropriations necessary to carry on the work. All this seems a great shame, and we believe that with the project so far along toward completion the part of economy would be to finish it now. As the best presentation of this viewpoint which we could make we give Mr. West's story in just the form in which he prepared it when it was assumed that as a matter of course the dam would be completed.—THE EDITOR.

FOR years Congressmen, engineers, business men and others advocated the construction of a dam or series of dams, across the Tennessee River at a point in north central Alabama, commonly known in that vicinity as "Muscle Shoals." This is simply a rocky, shallow place in the Tennessee River which prevents the passage of steamers up and down the stream. Many weird Indian tales and other stories are told of Muscle Shoals. It is said that during the Civil War so many horses were made to ford the river there, when a certain Federal army was crossing, that the rocky bottom was almost covered with horse shoes.

The advocates of a dam at Muscle Shoals pointed out that such a dam would make the river navigable for almost its entire length from East Tennessee to Cairo, Ill., thus opening up a vast amount of territory to cheap water transportation.

As a result of the agitation, the country adjacent to Muscle Shoals was carefully surveyed some years ago. So when we entered the war in such an unprepared state, and when it was found that we must have nitrate for explosives, quickly and in large quantities, the advocates of Muscle Shoals made their claims well known. They proposed to build the dam so that power could be generated for the manufacture of ammonium nitrate for explosives and at the same time the dam and locks would make the river navigable for almost its entire length.

After careful consideration the Federal Government finally decided to build a great nitrate plant at Muscle Shoals for the manufacture of ammonium nitrate by the cyanimide process and to be operated by steam generated electrical power until the great dam could be completed. It was further planned to use the plant after the war for the manufacture of nitrates for fertilizers as is being done in Norway, Sweden, at Niagara Falls and elsewhere.

The nitrate plant was practically completed and was in successful operation for a period of two months before the armistice was signed. While it cost an appalling sum of money, yet a wonderful piece of work is there to show for what was spent. Owing to the scarcity of coal, the nitrate plant was shut down until the great dam should be completed, a period roughly estimated at from three to four years.

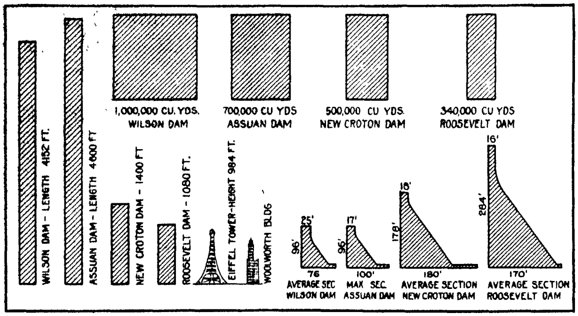
The Wilson Dam which is now under construction at Muscle Shoals will have, when completed, the largest volume of any masonry dam in America. After making a careful search in engineering literature and records, the writer finds that it will be the largest in the world except the Assuan dam across the Nile River in Egypt and possibly the Vyrnwy Dam in England. The two former will be exactly the same height, the Wilson Dam will be somewhat longer while all will have very nearly the same volume.

The accompanying diagram shows the comparative size of the Wilson Dam and a few other famous great barriers. The Wilson Dam will have a volume of nearly 1,000,000 cubic yards of concrete. If one concrete slab 1¼ inches thick by 18 inches wide suitable for one person to use as a walkway were built of the material, the walkway would extend entirely around the earth.

The downstream arm of coffer No. 6, and its connection with the construction bridge

In comparing the Keokuk Dam of the Mississippi River Power Company with the Wilson Dam as it is to be when completed, we find that while the former is over 4,000 feet long and 53 feet high, by 29 feet wide on top and 46 feet wide at the bottom, the Wilson Dam will also be considerably over 4,000 feet long, and will be over 98 feet high by 27 feet wide at the top, and 76 feet wide at the bottom. Thus it is seen that the Wilson Dam will contain considerably more masonry than the Keokuk Dam. The Keokuk hydroelectric development is generally acknowledged to be the largest in the world.

The famous Quaker Bridge Dam of the New York Aqueduct Commission is over 1,300 feet long and 270 feet high, but is much more lean in sectional dimensions. The Roosevelt Dam does not come in its class at all for this dam is very short and high. It is therefore seen that the Wilson Dam will actually be the largest dam in America. The Assuan Dam across the Nile River in Egypt is 4,600 feet long and is exactly the same height as the Wilson Dam will be when completed. It has a volume of 700,000 cubic yards of concrete. The Wilson Dam will have a volume of between 700,000 and 1,000,000 cubic yards.



How the Wilson Dam compares with other structures of the same sort

Not only will the construction of the Wilson Dam make the Tennessee River a very valuable waterway and enable the nitrate plant to be operated for the manufacture of fertilizers, but it will also provide cheap power for other industries that may want to locate at a desirable place where labor conditions and transportation facilities are so well adapted to such as at Muscle Shoals Muscle Shoals is situated approximately midway between Memphis, Nashville, Chattanooga and Birmingham The general local conditions which influence the methods and time of constructing the dam are especially good The project is well situated in regard to the labor market Sand, gravel and stone for concrete are also at hand. Railroad facilities are also good, as there are two roads near the site of the dam. The river is of great service in bringing in construction materials, and electric power is available for construction purposes at reasonable cost. Power at present is furnished by the Alabama Power Company from their Lock 12, hydroelectric development and the Warrior River steam plant, the former being 140 miles away, while the latter is 90 miles south of Muscle Shoals. It is interesting to note that this Warrior River plant is in the very heart of Alabama's coal mines, being at the very mouth of some of the mines on the banks of the Warrior River. (See author's article, "Warrior Steam Plant of Alabama Power Company" in *Power and Electrical Review* of March 19, 1918.)

Power is supplied from these plants over a single circuit, three-phase stranded copper transmission line The cables are each one-half inch in diameter, and are in a horizontal plane.

The power is transmitted at a pressure of 110,000 volts and is transformed to 44,000 and 2,300 for local distribution at Wilson Dam

Muscle Shoals is also well situated for the manufacture of fertilizer. Phosphate rock is one of the principal ingredients of fertilizer, and is at hand in great abundance. The cotton raising states, which are the great users of fertilizers, are well within easy reach either by rail or water.

It is very advantageously situated for the development of a great manufacturing center. Unlimited sites are available. With the completion of the dam, excellent water transportation will insure lower freight rates Moreover, the cost of building and heating is much less than farther north. There is an abundance of common labor, and it is a proven fact that skilled labor will flow to the point where there is a demand for it. With the growth and development of the Southern States it should be possible to supply their demands for many products from plants located at or near Muscle Shoals which now come from plants 800 miles farther north. Despite this it must be appreciated that it will require hard, honest work of trained experts, combined with a certain amount of financial assistance to bring the new industries to Muscle Shoals

A Murder That Never Happened Solved by the Airplane

THE "Mystery of Edwin Drood," the unfinished masterpiece of Charles Dickens, had never been solved until recently, and there is some doubt as to its solution even now, but the work of Percy T Carden (Putnam's), will go farther to satisfy the great family of "Droodists" than anything printed for many years The author has applied Mycroft Holmes' methods, for we must remember that the almost-sure Sherlock appealed to that super detective and relation Mycroft on very rare occasions Mr. Carden has examined the manuscript with painstaking care and has made many interesting discoveries, but his most remarkable feat was in securing the cooperation of Major Sippe, D S O, of Short Bros, in taking some remarkable views of the Cathedral and its precincts of "Cloisterham," as Dickens has disguised the charming Kentish City of Rochester The writer of this brief note attempted a few years ago to trace approximately the scene of the murder of Edwin Drood by John Jasper, but was unsuccessful, owing to topographical difficulties But with the aid of the airplane, all is different The seaplane flew low and the uncanny eye of the camera first at an elevation of 800 feet, and then at 500 feet unrolled the picture like a map Here spread before us is the whole scene of the murder, the very graves and vaults which are referred to in the story At last we can trace the comparative short journey from the stoneyard of Durdles, the perpetually inebriated mason, to the tomb where John Jasper cached the quicklime to obliterate the body of his murdered nephew. Step by step the many mysteries which surrounded the story are being solved The greatest danger is lest the game one day should have an end in a complete solution. But that day is not yet, but is probably far removed If Dickens, who had premonitions of sudden death, had only told his literary adviser, Forster, his son-in-law, Collins, who drew the cover, Sir Luke Fildes, his illustrator, or his son, Charles, how the story was coming out, what reams of paper would have been saved, for the literature on the subject is enormous, probably greater than for any other one book, excluding the Bible of course, so we turn and twist and split hairs usually to little purpose, but Mr Carden has altered this with his modern methods and now we can confidently hope that this mystery of mysteries may succumb to these methods which the great creator of Sherlock Holmes never dreamed of

Male Chicks from Large Eggs

A FRENCH scientist Lienhart, has carried out experiments which indicate that there is a correlation between size and weight of egg and sex of chick. The heavier eggs were found to produce a large proportion of males, the lighter eggs a large proportion of females For the successful application of the device, it was found necessary to use eggs produced by purebreds and from a pen of hens out of the same brood. It was found desirable, further, to set eggs laid at the height of production, as there is an apparent tendency with all hens to lay eggs of less weight at the beginning and also toward the end of a litter

The discovery, if such it can be called has not yet been fully exploited, and its limitations as well as capacities shown The reasoning which led to the first experiments is interesting

The experimenter had observed that in all breeds and varieties of poultry the male is markedly heavier than the female Through tests, he was aware also that this difference in weight was true of the chicks, being determinable in the first days of life He reasoned that the difference in weight would also be apparent in the egg

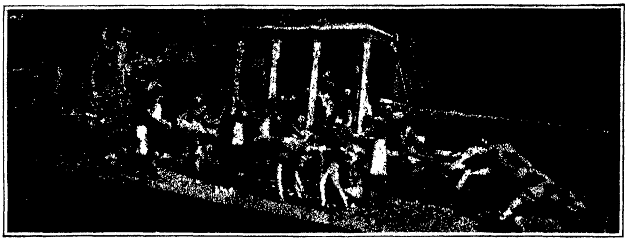
American poultry-raisers can be depended on to give the sex determination plan of Lienhart a prompt tryout The desirability of being able to regulate the proportion of pullets and cockerels in the hatch when setting the eggs is of prime importance Setting eggs at present the poultry raiser calculates on about fifty per cent females The males are a necessary evil, so to speak They are sometimes sold for broilers or fries at two months or later, in other cases raised to the roasting stage This necessity to hatch many males which are not needed requires more exhaustive poultry equipment than would be needed were it possible to regulate sex of the hatches Should sex-determination become practical, it would alter poultry conditions to a considerable extent, and result in the marketing of the prospective roosters in egg form, with the prospective hens reserved for hatching.

Interior of U. S. Nitrate Plant No. 2, showing 1536 electric ovens, to be operated from the power created by the dam

Looking Backward Four Thousand Years

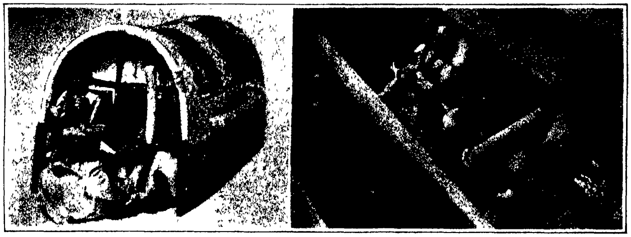
The Story of a Digger's Luck That Opened an Egyptian Wonder House

By Albert A. Hopkins



The largest group, in which Mehenkwetre superintends the counting of his cattle in this Noah's Ark of ancient Egypt

RUDYARD KIPLING, who is given to saying the right thing at the right time once remarked that archaeological excavations combined all the excitement of gold mining with an intellectual pursuit. This just describes it archaeological treasure troves are fascinating but likely to lead to disappointment, for the hand of the plunderer is often in evidence even though the perpetrator of the theft may be dead for a couple of thousand years For sheer luck the Egyptian Expedition of the Metropolitan Museum of Art almost holds the record By "luck" let it be understood that we do not mean aimless meandering over a given territory followed by a bonanza strike The archaeologist is a man of science, who is keen on surface conditions, history and everything which goes to the making of a scientific Sherlock Holmes



Left Mehenkwetre sits in front of his cabin and listens to the music of a singer and a harpist. *Right:* Brewing was not taboo in ancient Egypt. In fact they invented beer. Here brewing and baking are carried on under one roof

Two more scenes from the life of a magnate of ancient Egypt

The museum has had a concession for a number of years on the west bank of the Nile at Thebes After the war was over excavations were begun under the direction of Mr Herbert E Winlock with an efficient scientific staff At the beginning of the season of 1919 1920, a huge tomb of the Eleventh Dynasty was being "cleaned up" to get an adequate idea of its typography It seemed that nothing worthy of special note was to be discovered, but it is the practice of all good archaeologists to clear thoroughly, so that everything can be mapped out with that painful and mathematical accuracy, so dear to the heart of the archaeologist In this case patience brought a large reward

The site of the find is weirdly impressive Great buttressed cliffs of tawny limestone practically enclose a deep amphitheater a quarter of a mile in diameter Here was situated the mortuary temple of the last kings of dynasty XI, and high above around the rim of the depression are the black mouths of the tombs of the courtiers including that of Mehenkwetre, a chancellor and steward of the royal palace—one of the most powerful men in Egypt in B C 2,000 Mehenkwetre had chosen his site well and built a causeway up the side of the cliff at an angle of 20 degrees This leads to a portico, corridors and burial chambers which had been duly rifled at some former period Everything pointed to a dismal disappointment, but one day one of the men noticed that the chips of stone trickled from his hoe into a crack in the rock One of the explorers came along at this juncture and struck a match to light up the darkness in the fissure. One glance was enough; a native carried a hastily scribbled note to the other members of the Expedition to come quickly and bring electric torches The sun had set and the gloom of night so intense in Egypt had descended upon the cliffs, but when the archaeologists lay flat on the ground and shot a beam of light into the crack, one of the most startling sights that it was ever a digger's luck to see flashed before them In the small, totally untouched chamber were dozens of dolls and other figures, brightly painted, and looking like a glorified Noah's Ark The aperture was corded and sealed for the night and preparations were made to extract the last grain of knowledge out of this queer find. A room was cleared out in the house below, mirrors and reflectors were hunted up and for three days photographs were taken with the aid of daylight flashed along the corridor for one hundred feet by a mirror and a silver paper reflector Fortunately, the rock held together long enough to get out the objects enclosed in the chamber The room was not, as the explorers at first thought, a little burial chamber In fact it was a secret room in which part of the tomb equipment of Mehenkwetre had been placed A thousand years before his day it had been the custom for the tombs of the wealthy to contain such a chamber—called by the modern Arabs the "serdab"—in which the dead man's statue was walled up Later it had been the custom to put beside the statue a few figures of servants at their daily tasks eternally preparing food and drink for the dead owner of the tomb. Gradually these servants had been multiplied and the statue of the man himself been made smaller until at last his figure had been reduced to the same scale as the servants The latter were now grouped in model workshops or on boats, performing their tasks, and the master's statue had become a figure in the tableau, watching the work done for him The spirits of the little model workmen and the spirits of the food they produced eternally, supplied the spirit of the little statue—the soul of the dead man. This idea was universal among the Egyptians of 2,000 B. C.; every one

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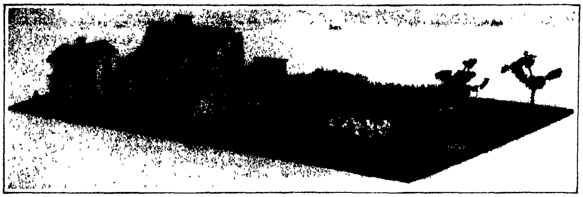
Seen through a hole in the rocks, a world of 4,000 years ago in brightly painted miniature, was revealed by the electric torch. A girl, still poising her basket of meats and stores, gases stonily at the invaders of the tomb

Showing the Little to Sell the Big

APPEARING at most of the big tractor shows of the past few months has been a bit of interesting modeling. The scene depicts in perfect duplicate a model farm with all the up-to-date equipment that goes to make farming efficient. There are harvesting machines, tractors, silos, windmill and chicken house Wheat and corn fields, together with a garden of growing vegetables, make the farm scene the more realistic. The good roads idea is also shown, as well as a concrete pavement extending over a babbling brook A model bridge completes the exhibit. All farm machinery is modeled after the big machines The miniature farm covers a space 4 by 8 feet and is realistically colored to make it attractive to all those who behold it



Model farm and farming equipment employed by a tractor manufacturer as an aid in selling his product to farmers

Washington's Rapid Transit Book Service for Legislators

YOUR Congressman, who perhaps with only half an hour's advance notice, is challenged to defend the high tariff on wool, finds a wealth of information handy, and telephones the Congressional Library for text-books on the subject. Are the books dispatched by a special messenger? Yes, but the errand bearer in this instance is charged with electricity and the books encased in an electric basket, are conveyed from the Library to the Capitol through a tunnel, the trip being made in five minutes

And the electric basket in all probability is not empty on its return engagement as doubtless the same Congressman or one of his colleagues has just finished with a book on the subject of irrigation in the West Literally speaking, this "traveling mechanical library" is operative to the Capitol, Senate and House Office buildings The attendant at the Library places the books in a leather covering, not dissimilar to a suit-case, drops the container in the electric carrier, touches an electric button, and, presto, the books are speeding on their way Returning from the assignment, the carrier automatically dumps the books and containers in a spacious box designed for the purpose

The mechanical arrangement is possible through a supply of power furnished by a motor in the basement of the Library, as depicted in the accompanying illustration The tunnel through which the conveyor operates is 5 feet wide and 9 feet high, large enough to permit of the passage of a person should the electric apparatus become inoperative for any mechanical reason

The baskets, made of iron, are 2½ feet long, 2 feet high and 5 inches wide, the front bars of iron being 3 inches apart. The books, after being encased in leather containers, are strapped in the basket The "traveling library" can be stopped at its destination, but the apparatus is subject to the beck and call of the Library when the electric button is pressed

Machinery that operates the book-carrying basket that runs between the Library and Congress. The basket is behind the electric bulb in center

Cutting Tools Which Contain No Iron

SOME more data are now given out regarding the non-ferrous cutting tool for cutting steel, known as Cooperite It is a signal departure for the leading material for cutting tools, both plain or high speed, in steel. This new material has nickel as its basis, the other components being tungsten, silicon, molybdenum and aluminum with a proportion up to 15 per cent of zirconium During the war it was made in this country on a semi-commercial scale and used for turning shells, and a plant for its production and the manufacture of tools of all kinds is being erected at Kokomo, Indiana.

Turning tools made of Cooperite are cast and then ground to shape, without any forging or heat treatment They are described as being exceedingly tough, with a fine silky fracture, and free from shrinkage and blowholes, and it is stated that they can be used for the bulk of engineering operations except those for which specially thin tools are required In tests made at the establishment of the Sheffield Testing Company the alloy was put in competition, on lathe roughing, with the standard high speed steel used by that company, which is declared to be superior to the majority of Sheffield high-speed steels In one series of tests, in which the tools were ¾ inch square, the depth of cut 3/16 inch, the traverse per revolution 1/16 inch and the cutting speed 128 feet a minute the weight of material removed from the test bar was 4.85 pounds per minute The tool of standard high-speed steel was reported "done up" after 2¾ minutes' work, while one piece of Cooperite lasted 14 minutes 30 seconds and was then "slightly worn but still cutting," and another, rather harder, worked 9 minutes 6 seconds before it was done up A demonstration of the melting of the material and the casting of tools was recently given at the works of the Sheffield Mercantile Steel Company, and the tools made were then tested by the testing company under conditions similar to those already described, except that the cutting speed was 120 feet a minute A Cooperite tool lasted 21 minutes 20 seconds, while one of the best high-speed steel broke down after 2 minutes 20 seconds

The Battle for Health

THE power of milk to destroy the fortifications of ill health, is demonstrated by an animated model designed by K E Parks, dairy engineer of the Dairy Division, United States Department of Agriculture, for exhibition at the National Dairy Show in Chicago, recently Supplementing milk posters, essays on products of the cow, milk dairies, and a health railway limited, this so-called "fort model" serves to stimulate drink-more milk campaigns and impress the lesson that milk is the arch enemy of under-nourishment

The idea of constructing such a mechanical device, requiring months of skilled effort, was brought to Washington by Miss M Jessie Hoover, milk utilization specialist, who observed an amateur arrangement of a fifth-grade pupil in the Pittsburgh schools who had equipped two forts, representing ill and good health Similarly, a Spokane boy last year built a health railway limited, thereby lending enthusiasm to a "drive" for increasing the consumption of products of the pail Somewhat complicated, novel in effect, and yet the most pretentious thing of the kind designed is the model of the Dairy Division

A miniature battle is waged against the forces of ill health, the milk bottle being victorious Picturesque scenery, a winding river, an open road, and soldiers emerging from a clump of bushes are represented by realistic effects in the mechanical formation the apparatus weighing about 250 pounds It is operated by a motor of one twenty-fifth of a horsepower, and tiny milk bottles typify soldiers who go "over the top" Five soldier-milk-bottles are operated along a conveyor, 4½ feet long, a wheel of 200 r p m sending the soldier across the river at the other end of the conveyor

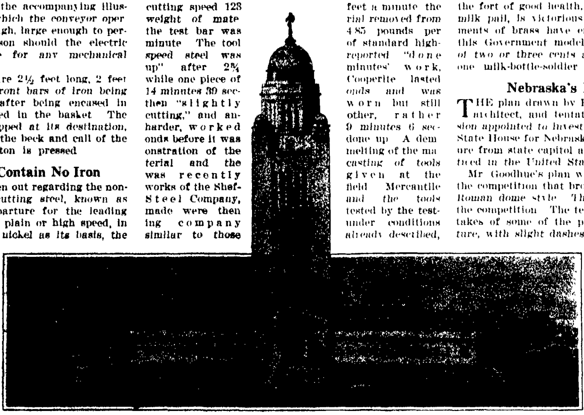
At the further end of the tramway, a mat forms a backstop to keep the invading soldiers from bouncing, they dropping into a hopper to be re-conveyed to the starting point ready for another siege As the soldiers emerge from the clump of trees a white flag at the other end of the conveyor is lowered, thereby signifying that the fort of good health, represented by products of the milk pail, is victorious Wood, sheet iron, and fragments of brass have entered into the composition of this Government model, which is operated at a cost of two or three cents an hour The mechanism fires one milk-bottle-soldier a minute.

Nebraska's New State Capitol

THE plan drawn by Bertram G Goodhue, New York architect, and tentatively accepted by the commission appointed to invest seven million dollars in a new State House for Nebraska is a bold and striking departure from state capitol architecture as it has been practiced in the United States

Mr Goodhue's plan was one of two out of the ten in the competition that broke away from the conventional Roman dome style The other plan did not figure in the competition The tentatively accepted building partakes of some of the principles of Egyptian architecture, with slight dashes of Spanish and Mexican

The striking feature of the design is the 400-foot tower, rising out of a great main building which has a base length of 400 feet The tower is surmounted by a small dome to be covered with golden tiles, and being located in the prairie country it will be a landmark for many miles The plan calls for a grouping of all necessary executive offices including a great memorial hall, about four courts



Plan drawn by Bertram G. Goodhue of New York for the new capitol of Nebraska

Fuel Conservation Opinions—I

What Leading Consumers of Fuel Have to Say About the Present and the Future

As Reported by Austin C. Lescarboura

> *THE basis of all industry is fuel—fuel in any form, whether it be coal, peat, lignite, oil, natural gas, wood, coke, or even water power For without fuel there is no turning of the wheels of industry, and everything must come to a standstill. Hence there is good reason why fuel conservation should be an oft-mentioned subject in the columns of this journal, and why we asked over seventy-five leading users of fuel for an opinion as to present conditions and future developments The large mass of information which these leading fuel consumers gave us could not be digested and boiled down for presentation in a single issue, hence the first part appears this week and is to be followed by the second part in an early issue* —THE EDITOR

THERE is no universal fuel What is an excellent fuel in one locality proves a quite unsatisfactory fuel in another locality Each industrial center has its own choice based on cost and usage, so that in any discussion of the relative merits and disadvantages of fuels we must not forget the element of place as well as time and general conditions

Both coal and oil Mr Thomas A Edison tells us are employed in his plants at Orange, N J Where it is *possible to use coal he prefers that fuel to all others* Oil is objectionable, since the price varies so much over a period of years Coal, says Mr Edison, is the best fuel there is very little variation in price or quality over a period of years, and judging from the immense deposits, there is no immediate danger of a serious shortage

Why Many Consumers Prefer Coal

And what Mr Edison says is typical of many other fuel consumers in the central and eastern United States For instance, Mr A K Birch, of the Allis-Chalmers Manufacturing Company of Milwaukee, Wis, *states that the power plant of their West Allis Works* uses coal because it offers the most certain supply and is readily stored in large quantities without great expense Coal, since it is relatively cheap, can be stored in large quantities without heavy expense and is obtainable from a great many districts

Mr Stuart Cooper of the Charleston Consolidated Railway & Lighting Company of Charleston, S C, is another advocate of coal, and may be considered as spokesman for our South Atlantic States Coal is the least expensive, states Mr Cooper, although he adds that this depends upon the location In his locality coal meets the requirements of his organization at the least cost

Of the same opinion is Mr P W Ripple, Chief Engineer of Power and Equipment of the Connecticut Company, which operates an extensive system of trolley lines throughout the State of Connecticut His organization, states Mr Ripple, uses coal because of its cheapness in that particular territory However, Mr Ripple is em*phatic in pointing out that the best fuel* available today depends entirely on locality It may be coal in one place, oil in another, water in another and so on

Turning to railroads, we again find that the locality determines the fuel Most of the Eastern railroads employ bituminous coal for locomotives and power plant fuel because of its availability, and because of the low cost and simple design of locomotives and power plants for its use The Illinois Central Railroad, speaking through its Vice President, holds this view, and states that it consumes such bituminous coal as is produced *by mines on or adjacent to its right-of-way* In the same general vein speaks the New York New Haven and Hartford through Mr W D Bean, Mechanical Assistant to the President This railroad, which covers the New England territory, employs bituminous and semi-bituminous coal, as well as coke, the first two fuels are employed for locomotive and stationary power plants, and the third for stationary power plants, where smoke and dust are not desirable The best fuel available for this railroad, we are told by Mr Bean, is coal preferably in the shape of high grade bituminous and semi bituminous coals from Pennsylvania. This is so for economic reasons, taking into account the heating value of the coal and its cost ready for use on their system

The New York Central Lines, according to Mr A T Hardin, Vice President, also use bituminous coal for engine fuel, except at one or two points where for the purpose of preventing smoke, it is necessary to use anthracite, and also in some of the forest regions where State laws require the use of oil Bituminous coal under present conditions is the most economical *fuel for general railroad use, states Mr Hardin, and* it is the only steam-raising fuel which is today available in sufficient quantities to carry on transportation and meet the requirements of the industries of the country

Another railroad that consumes bituminous coal is the Chicago Burlington & Quincy, Bituminous coals from Illinois, Iowa, Missouri, Wyoming and Colorado, sub-bituminous coals from Colorado and Wyoming, and fuel oil from Wyoming, are utilized, according to Vice President E P. Bracken. The coals referred to are favored because they are produced on the railroad's own line and are the most economical and readily available fuels The use of fuel oil was started to help the oil refineries dispose of their residuum oil. However, the improvement in cracking processes will more than likely result in a decreasing use and eventual abandonment of residuum oil as a locomotive fuel For their *purpose, states Mr Bracken, coal is the most suitable* fuel, because the railroad serves a large coal-producing territory

Fuel Oil and Its Advocates

Yet the use of fuel oil is steadily increasing Some concerns are making provisions to consume coal or oil at will, so as to take advantage of market fluctuations in either fuel Thus the various plants of the U S Industrial Alcohol Company are equipped to handle either of these fuel materials The reason given is that at times it is easier or cheaper to get one or the other, depending on the time and location The best *fuel available today, states this company, depends on* the operation for which the fuel is used, the location, labor conditions, and railroad facilities The choice between the use of fuel or coal in most cases is purely an economic one, but oil is, of course, easier to handle and to regulate, and requires less labor But when the labor involved in the utilization of coal is figured in as part of the cost of coal, the question is purely an economic one

It is in southern California that fuel oil is widely employed One large user of this fuel is the Southern California Edison Company of Los Angeles This power company is using crude oil because it has been the most economical and, by reason of its local production, the most readily obtainable fuel available to southern California consumers According to Mr R H Ballard, Vice President and General Manager *of that* company, the increase in the price of crude oil in California within the past four or five years from 50 cents to $2 00 a barrel, prohibits its continued use in large quantities as a fuel for the generation of electric power At any rate, states Mr Ballard, as a fuel for ship propulsion crude oil has a superior use for which its limited supply should be conserved Furthermore, the best fuel available today for the generation of electric power is "white coal"—the inexhaustible hydro-electric power of the mountain streams—of which California is fortunate in possessing 15 6 per cent of the total potential water power in the United States

Down in Louisiana the New Orleans Railway & Light Company, according to its Superintendent of Power, Mr Frank Frost, has three steam-generating stations, two of which are old and inefficient and are used only in case of emergency In the main station, this company burns both coal and fuel oil Just now, coal is slightly less expensive than the fuel oil equivalent; but this company has a two-story boiler room the second story of which is so constructed that it can only burn fuel *oil under boilers on that floor*

Fuel oil is steadily coming into its own for maritime purposes One by one the largest liners are being converted into oil burners, although it appears that there are very definite limitations to the size and kind of ship on which oil firing boilers can be employed to the best advantage. Thus most of the large steamship companies use either fuel oil or coal on their ships, depending on many factors in each case

With the Users of Natural Gas

In certain sections of the country natural gas is available for heating, illumination, and power purposes, Thus in California, there are districts in which natural gas is available, and it ranks with fuel oil as the best fuel obtainable in the Southwest. In the Middle West natural gas is available in many cities Typical of the use to which this fuel is put is that of The Union Gas & Electric Company of Cincinnati, Ohio. Natural gas from West Virginian fields is being employed by that company, according to its Mr DeForest, whenever available, which is throughout the year except during winter months when the supply is limited to domestic needs, all *the* industrial users being *cut off* During the winter the fuel of that company consists mainly of Logan County semi-bituminous coal running about 13,000 B. T U per pound, and a lesser amount of other coals picked up on the market The main supply of that company's coal is from its own mine. Mr DeForest states that coal, either powdered or gasified after taking out the by-products, is the best fuel, oil, using the lower grades, is the second best; and natural gas is the third best, because as a rule it is too valuable to be consumed for power purposes

What About Water Power?

When asked regarding the future of water power in the United States, Mr Edison stated that he believed that in years to come coal would rise in price and this would insure the utilization of all the water powers commercially *available, based on the standard of the* price of coal then in force Indeed, the price of coal, says Mr Edison, sets the value of the water power.

The total available water power of the United States would, if completely utilized, provide only a minor part of the power now produced by the burning of fuel, we are reminded by Mr Edward W. Jones of the Laclede-Christy Clay Products Company of St Louis. More complete development of our hydraulic power resources is desirable since it would lower power costs in some localities, reduce the *fuel transportation* problem and decrease our annual consumption of fuel. Water power cannot, however, be expected to provide more than a small contribution toward answering our big fuel problems.

The future of water power in the United States, especially in California, is quite promising, according to Mr. Ballard of the Southern California Edison Company The passage of the Federal Water Power Bill, as well as the scarcity and increasing price of fuel, has given a great stimulus to the development of hydro-electric power in the West The lower cost of water *power in comparison* with power produced by steam is causing a gradual industrial movement westward to the centers of hydroelectric power, according to this authority This movement has and will continue to quicken the need for the development of the water power resources of the West. The Southern California Edison Company alone has a hydro-electric power development program which will bring into production approximately 4,000,000 horsepower. Of this amount, 1,000,000 horsepower will be developed on the San Joaquin River, known as the Big Creek Project, and the remaining 3,000,000 horsepower will be produced along the Colorado both above and below the Grand Canyon.

Conservative estimates indicate that the *normal growth* of California, continues Mr. Ballard, combined with the western movement and the electrification of certain railroads, will absorb this immense amount of power by 1945. The consummation of this complete program will require an investment of approximately $850,000,000 for the construction of the power plants, transmission and distribution systems.

Water power becomes increasingly valuable with the *character of its development*; that is to say, the ideal is to maintain a uniform flow of water throughout the year, states an official of the American Engineering Company of Philadelphia, Pa The more money that has been spent for storage of water and for stand-by steam plant service during annual periods of low water, the less valuable the water power. The principal element of cost in the water power plant is an investment

(Continued on page 375)

Cold Vulcanization of Rubber

A New English Process with Many Advantages Over the Old Ones

By F. Rowlinson

IN English scientist of some standing, Mr. Peachey, the Lecturer in Chemical Technology at Manchester University, has announced a new process of rubber vulcanization, which it is claimed will revolutionize many branches of rubber manufacture. By the use of two gases, both cheaply and readily obtainable, he has perfected a scheme of cold vulcanization of rubber which combines the ready application of the present "cold" process with the fine quality of the hot process

The mechanism and chemical changes involved in the new process can better be understood when the nature of the rubber and the processes of its manufacture are considered. Rubber is the latex of a species of tropical tree. The nature of this latex and the part it plays in the life of the plant is not clearly understood. It is entirely distinct from the sap which by its circulation gives life to the plant; indeed, the tree seems to suffer no harm by its removal The latex is tapped from the tree by incisions made in the bark, and is collected—a thick viscid liquid of varying color. After exposure to the air, the latex undergoes a spontaneous and remarkable change, particularly if heat is supplied. From a liquid it slowly thickens into a semisolid mass, still retaining some of the stickiness which characterizes the liquid The change from raw latex to caoutchouc is hastened by working the mass, and in its later stages by curing over fires At the same time, leaves, stalks, small stones and other foreign matter are as far as possible removed The cured caoutchouc is a solid mass of varying color according to its source and treatment. On application of even a moderate amount of heat it rapidly becomes soft and viscous, recovering its solidity at low temperatures A high temperature destroys and decomposes the mass into a sticky liquid which does not regain its properties on cooling. The nature of the change from the raw latex to crude caoutchouc is thought to be partially an oxidation effect, but chiefly to be due to molecular condensation or polymerization An artificial synthetic organic compound, isoprene, exhibits similar properties, and has been called artificial rubber Its manufacture is, however, prohibitive in cost.

The crude caoutchouc is further purified mechanically by working between knives and rolls to insure homogeneity and freedom from foreign matter The purified caoutchouc is, however, of little use in the arts and sciences. Though possessed of a slight elasticity at ordinary temperatures, it becomes plastic and soft at quite moderate temperatures, and further treatment is necessary. This is known as vulcanization

In 1839 Charles Goodyear, of New Haven, discovered that rubber (or caoutchouc) when masticated with finely-divided sulfur at a fairly high temperature, undergoes a remarkable change The sulfur combines with the rubber and the vulcanized mass is found to retain its elasticity to quite high temperatures besides showing a notable increase in tensile strength The new product found a speedy application in industry, where its elasticity, freedom from corrosion and wet-resisting properties, made it a valuable material

In 1846 Parkes made known his cold vulcanization process This consisted in the use of sulfur chloride in solution in carbon disulfide Rubber goods steeped in this solution became vulcanized in the cold, better still, articles were suspended in an atmosphere of sulfur chloride gas. By this means, textile fabrics having first been impregnated with rubber either by rolling it into their pores, or by steeping them in a solution of rubber and allowing the solvent to evaporate, the rubber treated article could then be cold vulcanized by treatment with the sulfur chloride The Parkes process made possible such things as the mackintosh and other rubber fabrics, rubber shoes, etc. Cold vulcanized rubber is scarcely as high in its qualities as hot vulcanized but the convenience of the process outweighs this objection for many uses Improvements due to various inventors were afterward made in both processes, notably in the hot process by the incorporation in the mass of catalytic agents such as litharge, magnesia, or antimony sulfide These either promoted much quicker vulcanization or reduced the temperature required, a small proportion only was required as a rule to give the effect Neutral substances such as barytes, zinc white, etc, may be used to load the vulcanized rubber, and pigments may be added to give color. Vulcanized rubber attains its maximum elasticity when it contains from 2 to 2.5 per cent of sulfur Over-vulcanized rubber becomes hard and inelastic It is known as ebonite or vulcanite and is the familiar substance of which fountain pens, etc, are manufactured

This summarizes the state of the rubber industry at present The discovery of a new process of vulcanization combining the virtues of both hot and cold processes, with some of its own, promises to cause a revolution of methods The basis of the new process is common knowledge to every chemist When the two gases, sulfur dioxide and sulfuretted hydrogen, are brought together, dense clouds of sulfur, in a very fine state of division, are formed Both gases are very cheap and easily obtained—in contrast to sulfur chloride and carbon disulfide, which are expensive and objectionable in use Now if raw caoutchouc be masticated in a closed machine, and sulfur dioxide gas be pumped in, the rubber will absorb a certain amount in its pores If now sulfuretted hydrogen be admitted to the machine an immediate precipitation of sulfur in the finest state of division, takes place *in the very mass* of the rubber Vulcanization takes place at ordinary temperatures, and by alternately admitting the gases, any degree of vulcanization may be attained Further, to secure vulcanization by ordinary processes, it is necessary to have some excess sulfur, which is detrimental to the properties of the finished material The new process leaves no excess of sulfur Owing to the fact that the process is carried on in the *mass* of the rubber *at ordinary temperatures* it is practicable to in-

(*Continued on page 377*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

How To Get Back To Normal

To the Editor of the SCIENTIFIC AMERICAN

This is the year of liquidation and readjustment in business. The present condition can be best expressed as follows:

No selling, no buying;
No buying, no making:
No making, *then what?*

Falling sales, unemployment, idle plants, decreased production, high costs, and heavy losses, are elements in the present situation, and can only result in one thing—depression and business stagnation—unless constructive steps are taken to get back to normal quickly

There should be plenty of business ahead. Our children need schools; our families need homes to live in; our cities require new public buildings; our automobiles, trucks and farmers need roads; our railroads need repairs and new tracks, roadbeds and equipment, our public utilities need betterments and replacements; our furnaces and stoves require fuel; our people need shoes and clothing. In addition to all of this, the world needs food.

Here is a constructive program based on years of experience in industry:

1. Determine normal capacity of machines, working places, departments and plants, in hours. This may be 75 to 85 per cent of your possible capacity.

2. Standardise overheads according to departments, with due consideration to reductions in same, determining what these overhead rates would be for your normal capacity.

3. Determine from estimates, records of past performances, by conferences or by observations, what would be fair and attainable production standards per hour for your various operations, using your normal capacity as a basis. Do this for the reason that productivity (relative amount produced per hour), is the gage of economy and efficiency in manufacturing.

4. This will enable you to determine various combinations of the standard quantities of the various products you can make

5. Using *current prices for labor and material*, and your standardized overhead rates, the cost of these products, at normal capacity can be determined

6 A fair and reasonable profit added to costs—or using *costs for a time, if you have to*—will *mean prices* which will bring business, because greatest volume of work goes to that concern whose prices reflect normal operating conditions

7 Now call in some of your best workers as representatives of their fellow workmen, and outline to them what your present conditions are and what you want to do, explaining the above points, especially number 8, as they relate to unemployment, reduction in wages or hours, and company losses.

8 Place these plans before your banks, as a basis for credits and financial help.

9. At the same time get your sales and advertising campaigns tuned up with the above, giving due consideration to time payments, discounts and the like

10. Charge the differences between actual and standard overhead costs into an adjustment account for the time being, which will decrease as you approach normal capacity, and which will cease when you reach normal This loss will be much less for the coming year than it would otherwise be as plants are now operating. As you go above normal and reach possible productions, this loss would be offset in whole or in part by credits to the adjustment account The balance, loss or gain, at the end *of the year*, would be carried into profit and loss

The above is not mere theory The steps have been tried and proved out and are practical and workable They have been used by plants before the war and since the war.

Anticipating normal conditions will bring normal conditions more quickly

C. E KNOEPPEL.

The Einstein Contest and the Readers

To the Editor of the SCIENTIFIC AMERICAN:

As an interested bystander in the recent contest for the Einstein Essay Prize, I wish to point out two utterly false generalizations on matters pertaining to philosophy in the composite third essay published in your columns Imagine my surprise when stumbling in the opening paragraph upon Auguste Comte's (1798-1857) thoroughly artificial genesis of human knowledge, *long ago discredited I mean the assertion that human* knowledge has passed progressively through three stages, the theological, the metaphysical, the scientific The positivism of Comte does indeed survive in this *crude form in innumerable school texts*, but I did not look for this sort of thing in a supposedly original contribution to the Einstein literature

The assertion that "the ancient Greek philosophers believed *that they could tap sources of* knowledge pure and absolute about the nature of time and space by sitting down in a chair and reasoning about them," etc., does indeed have the ear-marks of originality, if ignorance may be called original. *Shades of Aristotle and* Zeller!

J J E FREDERICK, Ph D.

Pomeroy, Wash

Time, Space—and Motion

To the Editor of the SCIENTIFIC AMERICAN

I am a reader of your magazine and am interested in the "Einstein" articles. In the SCIENTIFIC AMERICAN of February 19, 1921, under the heading, "The New Concepts of Time and Space," I read, 'But did you ever observe anything suggesting the presence of time in the absence of space or vice versa?' While this is true it is also true of all creation—nothing could exist without space to exist in But did you ever observe anything suggesting presence of time in the absence of motion? Time is the product of motion

Suppose something to go wrong with the force behind all motion and that all motion ceased (including *growth, waste and repair*, molecular atomic action and every motion known or unknown) where then would we find a suggestion of time? And again suppose all things to move in parallel lines at the same *velocity where then would we find time? Conclusion*—time is the product of two or more motions either of different directions or of different velocities While time cannot exist without space, space can exist without time, but motion cannot exist without time or time without motion

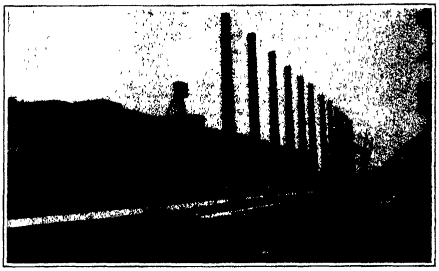
LEWIS S. HOPLEY

East Hampton, Conn

Machine-Made Window Glass

How the Great Sheets of This Difficult Material Are Made and Handled

By Robert G. Skerrett



Outside view of the factory where window glass is made by machinery

IN the manufacture of glass generally, the labor charge constitutes the largest single item of expense This fact has inspired the inventor to evolve various mechanical agencies designed to reduce manual work as far as practicable, and it is noteworthy that a good deal of success has rewarded these efforts Probably nothing in this direction has been more brilliant from an engineering standpoint than what has been done thus to cheapen and to amplify the production of window glass The departures from the art of the *hand-blown method* properly divide themselves into two classes, and the present purpose is to treat of that one which fundamentally is the more revolutionary

Nearly four decades ago an ingenious man by the name of Clarke essayed to produce sheet glass by mechanical means, and his example started others along the *same path only to drop by* the wayside because of seemingly insurmountable obstacles of one sort or another But about 1908 one creative genius, Irving W Colburn, of Franklin, Pa, profiting by the experience of his predecessors, brought out an apparatus for the manufacture of window glass that possessed features of especial promise With it, it was practicable to draw long sheets of glass of considerable width and of various desired thicknesses Even so, there was much to be done to fit the machine for industrial service, and after years of costly experimenting, in which several men took a part, the patent rights were sold for something like $15,000 Subsequently, control of the invention was secured by E D Libbey and Michael J Owens, both of whom have figured conspicuously in modernizing the making of glass

It was not, however, until S B Henshaw, acting for Messrs Libbey and Owens, took over the problem and rounded out the whole process that Colburn's original conception was pronounced ready for application on an imposing scale As a result, there is today at Charleston, West Virginia, a magnificent plant of many buildings, and there are installed 12 automatic sheet glass drawing apparatus capable of turning out an immense amount of window glass in the course of a year The procedure is a continuous one, and as long as a machine is active it produces glass of a prescribed width and thickness hour in and hour out

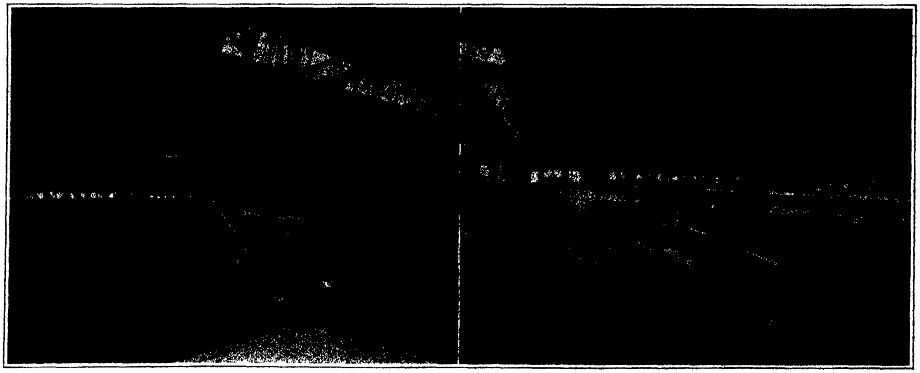
Some idea of the *rapidity of operation* can be gathered from the fact that a machine will deliver a sheet 5 feet wide at a rate ranging from 24 inches to 100 inches in length every sixty seconds The thickness determines this figure That is to say, a sheet 1/24 of an inch in thickness comes over the roll at a speed of 8⅓ feet per minute, while glass ¼ of an inch thick is made at the rate of 2 feet a minute The sheet goes right from the roll into the lehr or annealing furnace, where, after a journey of 200 feet in a gradually lowering temperature, it passes out to a belt conveyor There, the edges are trimmed automatically and the glass is cut crosswise into specified lengths Up to this point every operation is performed mechanically

To appreciate what all of this means, let us go back to the very start of the work and follow it through from the raw materials to the stage just described The batch for window glass is composed of sand, salt cake, and lime, with a small amount of powdered coal or charcoal In some instances soda ash is substituted for the salt cake These ingredients, at Charleston, are severally scooped up mechanically from the railway cars in which they arrive at the plant and are deposited into elevated concrete bins From these storage tanks, the sand, salt cake, lime, etc, flow by gravity into an electrically-driven mixer, which stops successively under each bin to receive the required amount of the different raw materials. The batch, so measured and prepared next goes into a hopper which feeds a belt conveyor, and the latter, in its turn, carries the mixture to the chutes reaching directly to the receiving ends of the melting tanks. There, an attendant, by raising a lever, lets the stuff drop into the tank to replace the molten glass drawn off at the farther end of this furnace A single man can thus take care of six tanks, while another operative reverses the flames of burning gas—issuing alternately from one side of the furnace to the other—of the same group of tanks. This reversal is necessary in order to maintain more nearly uniform the heat of the furnace structure, which is designed to work on the regenerative principle.

No small part of the success of the Charleston plant is due to the way in which the melting tanks are built of blocks of refractory materials and the furnace walls are cooled by circulating water and air to insure relatively long life. These tanks, exposed to a temperature of from 2,600 to 2,800 degrees Fahrenheit, have been run continually for stretches of eighteen months without calling for troublesome repairs or their shutting down Each tank has a 30-pot capacity holding many tons of molten glass, and the daily yield of glass is equal to the production of 44 blowers in a so-called hand-working establishment The molten glass that is formed into sheets is withdrawn from the furnace by a simple yet, withal, an amazingly effective attachment which, in principle, is akin to the gathering rod or "punty" of the ordinary glass blower

This is one of the features of the machine which has required a protracted period of research; and in its present form is nothing more elaborate than a heavy iron rod, suspended horizontally by a number of copper straps, which can be raised and lowered. This rod, technically termed a "bait," is dropped into the molten glass within the tank, where it cools the glass immediately in touch with it This induces adhesion, and when the rod is lifted electrically it pulls with it a *trailing plastic mass* of incandescent glass about two inches thick and as wide as the bar is long After mounting a distance of 30 inches the glowing sheet, extending upward from the tank surface and adhering to the bait, is drawn over a bending roll and led thence on to a flattening table. This table is really a continuous belt made up of a series of closely spaced metal slats, and is about 6 feet long and 72 inches wide. The belt spans the gap between the furnace and the lehr, and moves with the sheet of glass In order to keep

(*Continued on page 378*)



Left: The feeding end of a battery of melting furnaces or tanks, showing the chutes by which the batch is intermittently discharged into the tanks to make up for the molten glass removed by the glass-drawing machines. *Right:* The exit end of the lehr of one of the glass-drawing machines. Before leaving the belt conveyor the glass is cut into sheets of large size; the market sizes are later cut from these by hand

Rolling window glass in sheets by a continuous process

The Italian battleship "Leonardo da Vinci," sunk during the war, lay upside down, with guns and turrets in the mud These were cut away, and by filling the side tanks with water the ship was rolled over as here shown

A great feat of ship salvage: Righting the Italian dreadnaught "Leonardo da Vinci" by rolling it over

A Great Feat of Ship Salvage

IT will be remembered that during the war, one of the finest and most modern of the Italian dreadnaughts, the "Leonardo da Vinci," was sunk in harbor Before her final disappearance the great ship of 22,000 tons' displacement turned turtle, and when the divers investigated, they found that she was lying deck down upon the bottom Here, indeed, was a problem, inasmuch as the five heavy barbettes and their turrets, with the 12-inch guns, of which there were thirteen, were buried in the mud These heavy weights acted is a sort of enormous deep underhung ballast to prevent the lifting and righting of the ship

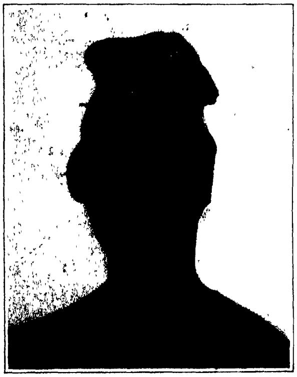
We have already in a previous issue described the operations of getting the hull to the surface and in dry dock First, the divers cut away the five turrets with their thirteen guns, lightening the ship to that extent. The hull was then made watertight, raised bottom up, floated into dry dock and unwatered there, the superincumbent mass being carried upon special supports of cribbing and heavy timber struts judiciously disposed under the whole deck of the ship so as to properly receive the great concentrated loads which are peculiar to battleship construction After additional deck weights had been removed, the whole hull was made thoroughly watertight, the dock was flooded and the ship, still bottom up, was floated out into deep water The task remaining was to roll the ship over into its normal position This was done by gradually flooding the side ballast tanks and submerging one side of the ship deeper and deeper until, by flooding the bottom tanks adjoining the already-flooded side tanks, it was possible to bring a righting moment into effect, which pulled the ship entirely over until she floated, deck up, as shown in our illustration

An Improved Gas Mask for the Navy

WE show here a photograph of a type of gas mask used in the Navy during the later days of the war which is not generally familiar to the public Most of us know the gas mask which carries a container, shaped like a tin can, over the mouth, strapped on around the head. This new type is in several ways superior to the other

It consists of a rubberized canvas face mask, which must, of course, fit closely around the face to be effective in keeping out poisonous gases To this is attached a headpiece made of tin which supports a tin canister, held in place by leather straps; the canister, in turn, connects with the face mask by two tubes which enter the mask back of the glass windows for the eyes. At the back of the container is an inlet for the air, which passes through the chemically-treated filler in the container, down through the tubes to the opening between the face and the mask and is inhaled by the wearer. Air is exhaled through slits in the flat, hexagonal rubber flap at the top of the nose-piece.

These openings stay closed during inhalation. The whole apparatus weighs only about 2¾ pounds, and is so simple that it is very easily adjusted; and it is so compact and fits so well that the danger of its being knocked or shot off is not nearly so great as with the old style mask The container, which acts as a protection for the top of the head, may be removed easily if it should be damaged or when the chemicals used in treating the filler have deteriorated, and a new container substituted, in fact, containers which have fillers of different chemical substances are adjusted to the mask to meet the various gases to which the wearer will be exposed For example, sailors who are stationed high on the masts of our warships where clouds of smoke pour out of the funnels, wear containers treated to neutralize the effects of carbon monoxide gas, since smoke is composed largely of carbon monoxide, a deadly poison, and chemical processes have been worked out for the treatment of fillers to be used to counteract the action of other poisonous gases which are used most commonly on the battlefield The mask we describe will counteract poisonous gases for as long a period as six hours The older type can be worn for two and a half or three hours This difference in time is due in part to the larger container used on the new mask



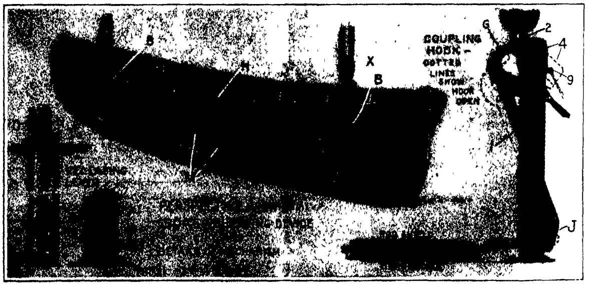
Improved Navy gas mask with detachable container. Each man has several containers treated to counteract different poison gases

Ship's Boat Launching Gear

IT is a curious fact that in the endeavor to make the *steamship safe against the accidents of the sea,* the naval architect has failed to give adequate attention to the provisions for saving the passengers or crew when a ship is sunk by accident Proof of this was seen in the loss of the 'Titanic'

The lifeboat launching or releasing gear which we illustrate has been tested by the Steamboat Inspection Service of the Department of Commerce, which expresses the opinion that it possesses considerable merit as a boat disengaging apparatus and recommends that if its parts which are subject to friction be constructed or lined with non-corrosive metal, it be approved for use on steam vessels under the jurisdiction of the Steamboat Service The report speaks approvingly of the releasing gear because of its positive action, due to its rigid releasing agencies in the form of steel rods operated from the releasing lever in the center of the boat

The device as shown consists of two upright standards, one *at each end of the boat At the* upper end of the standard is a releasing hook (G), which engages a U bolt (2) of the hoisting tackle Each hook is coupled by means of a link arm (I), to a bellcrank lever (J), which is held in the bottom of the standard (B) Each bellcrank lever is coupled by a connecting rod, (M) with the actuating lever, (N) in the center of the boat This lever is locked in its normal position when the boat is being raised or lowered by a catch (O), at the upper end of the lever, which engages the boat's thwart in which the lever is carried. When the boat has been lowered to the water, the operator grasps the lever (N), thereby releasing the catch (O) and as the lever is swung over the two connecting rods (MM) act through the bellcrank levers (J) and the connecting rods (I) to pull the releasing hook down into the position shown by dotted lines in our illustration, thereby quickly and simultaneously releasing the whole of the hoisting gear As a safety device to be used in northern climates, where the releasing gear may be clogged by ice, the U-shaped keepers (4), which are engaged by the hooks, are pivotally connected to the top of the vertical standards which carry the gear To release these a split pin (9) is pulled out and the blow of a hammer suffices to knock the keeper clear of the hook as shown by the dotted lines The construction is simple, rugged and positive in its action, conditions which are fundamentally necessary in a reliable boat-releasing device The design worked out and patented by Mr John A McNabb, a marine engineer of Bayonne, N. J



A new type of boat-releasing gear, approved by the Steamboat Inspection Service

The Heavens in May, 1921

The Chief News of the Month Afforded by Comets and Attendant Meteors

By Professor Henry Norris Russell, Ph.D.

TWO comets are now in sight—perhaps three, as the one discovered independently by Taylor and Skjellerup last December may still be visible in large telescopes The next in order of discovery was first detected by Reid at Cape Town on March 13th, before the preceding article of this series was written, but while the writer was at sea At this time the comet was in Capricornus, just south of the ecliptic, and 18° south of the equator. It moved steadily northward, and by this time is well above the equator, and much brighter. Elements of the orbit, computed independently at the Yerkes Observatory and the University of California, agree closely The comet is moving in a retrograde orbit, inclined about 45° to the plane of the ecliptic, and had just passed its ascending node when discovered It was then about 130 million miles from the sun, and 160 million from the earth, and rapidly approaching both It will come to perihelion on May 9th or 10th, according to the two calculations, at almost exactly the earth's distance from the sun, but more than 40 million miles north of the plane of the ecliptic Its closest approach to the earth will occur about the beginning of May, at a distance of roughly 50 million miles Since the comet and the earth are going about the sun in opposite directions they will pass one another swiftly, and their mutual distance will increase to a hundred million miles shortly after the middle of the month At brightest the comet will probably be a little above the sixth magnitude—just visible to the naked eye, and easily so in a field glass Its rapid motion makes extension of even rough prediction difficult, the published ephemeris running out on April 28th At that time it will be about half way between Alpha Cygni and Alpha Cephei, and moving almost due northward It will pass near the latter star, and Beta Cephei, come within a few degrees of the Pole-star (on the side toward Cassiopeia) on about the second or third of May, and will then pass on toward the head of Ursa Major No information regarding the physical appearance is at hand, but it is practically certain from the character of its orbit and its brightness that the comet cannot be of short period

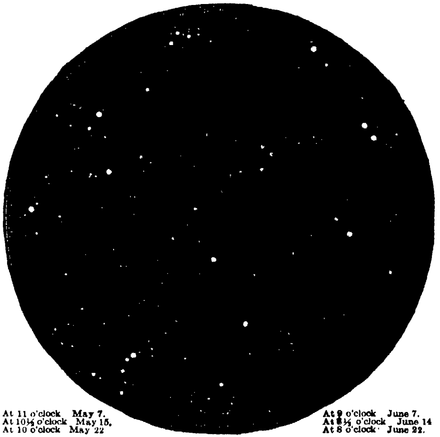
The most recent discovery is of an "expected" comet, and one of unusual interest--the periodic comet of Pons and Winnecke This was first seen by Pons in 1819, but though the observations then secured showed it to be of short period, it was lost again until 1858, when Winnecke rediscovered it Since then it has been seen in 1869, 1875, 1886, 1892, 1898, 1909, and 1915—its period being a little more than five and a half years It is a member of Jupiter's family of comets and at various times it has passed close to the great planet, so that its orbit has been considerably changed by the perturbations Since 1819 the period has increased by three months, the inclination from less than 11° to more than 19°, and the perihelion distance from 70 to 94 million miles The last of these changes is of great interest, for it brings the comet's orbit very close to that of the earth A century ago it passed more than 20 million miles inside our own track, but in 1905 it came within three million miles (inside again), while this year it will actually pass outside the earth's orbit, at a distance of a million miles or so

The exact date of the comet's return had been uncertain, for it passed close to Jupiter in 1918, and the resulting perturbations of the orbit have not yet been computed The region of the sky in which to watch for it was, however, pretty closely assignable, and, on April 10th of this year it was detected by Professor Barnard on a photograph made in the search for it At that time it was in the constellation Corona Borealis, in 15h 35m R A, 37° north declination, and was moving northeasterly at the rate of 50 minutes of arc per day It was of the twelfth magnitude, and therefore invisible except in large telescopes

In a case like this, when the track which a comet is following is fairly well known, although its position on that track is more uncertain, the first observation serves to define the latter By comparison with the "search ephemerides" computed in advance, with different assumed dates of perihelion passage, it appears that the comet will reach perihelion about June 14th. Dr Crommelin, the distinguished computer of the motion of Halley's comet, predicted that this would occur on June 15th—with an uncertainty estimated at ten days, arising from the fact that he had estimated the effect of the perturbations by Jupiter, instead of taking the months of labor required to compute them exactly.

The Comet and Its Meteoric Swarm

Had the comet come a week later it would have passed the point of close approach of the orbits at the same time as the earth, and would have come within two or three million miles of us—perhaps closer. As things are, it will get there first, and be about nine million miles ahead of us All through the first half of June it will be nearer to us than comets usually come, or than any other body except the moon ever comes, but its minimum distance will in all probability be several millions of miles—just how many can be told when a few more observations have been secured and a new orbit calculated Before the exact date of the comet's return was known there appeared to be a chance—though a very small one—that it would actually hit the earth; but this seems to be placed now quite outside the bounds of possibility Though we have no reason to expect anything so sensational as this, the encounter may nevertheless—and probably will—give us something to look at.



At 11 o'clock May 7.
At 10½ o'clock May 15.
At 10 o'clock May 22

At 9 o'clock June 7.
At 8½ o'clock June 14
At 8 o'clock June 22.

At 9½ o'clock: May 30

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later 12 o'clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

In 1916, eight months after the comet had passed the region where the orbits come near one another, large numbers of meteors were seen while the earth was passing the same region (which it does in the latter part of June). As in the case of all meteoric showers, these meteors moved in parallel lines which, by the effect of perspective, made them appear to radiate from a point in the sky near the end of the handle of the Great Dipper Dr Olivier of the University of Virginia and Mr Denning in England, pointed out independently that this was exactly the direction in which meteors following along the track of the comet should appear to come. This added another member to the list of meteor showers known to be associated with comets No shower of meteors from this radiant had ever been observed before 1916, but this was to be expected for in previous years the orbit of the swarm lay so far inside that of the earth, that even the outliers did not reach us.

This year we shall pass within about one million miles of the central track, instead of three, and two weeks behind the comet instead of eight months. All the probabilities are therefore in favor of a conspicuous shower of shooting-stars. The most probable date is about June 28th, but it may come a little earlier or later, as the orbits of the earth and the comet run close together for a short distance The moon will be in her last quarter and out of the way, since the meteors overtake the earth, and strike the evening, rather than the morning, side of it A careful watch of the skies on and about this date is to be recommended to all star-gazers.

As for the comet itself, no ephemeris predicting its future position in the skies is yet available. Since in any case it is unlikely to become visible to the naked eye, and perhaps not even in a small telescope, this is of little importance from our present viewpoint.

The Heavens

Our map exhibits the evening constellations so clearly that little need be said The Great Dipper, high in the north, points downward to the Pole-star, and in the opposite direction, following the curve of the handle, to Arcturus. Spica is well up in the south, and Antares is low in the southeast Due south, and low on the horizon, observers within the tropics, or near them, may see the Southern Cross

Leo is much the most conspicuous group in the west, and is brightened by the presence of Jupiter and Saturn Gemini and Auriga are setting in the northwest, Cassiopeia swings low on the northern horizon, while Cygnus and Lyra are in the northeast and Aquila due east. Hercules, above the last, and Ophiuchus, in the southeast, complete our list.

The Planets

Mercury is in conjunction with the sun on the 10th, passing actually behind the body of the sun, so that he would be occulted if we could observe the phenomenon. He is however practically invisible except at the end of the month, when he is an evening star, setting at 9 P M., and readily visible in the twilight

Venus is just past inferior conjunction, and a morning star once more, rising about 4:10 A. M. on the 1st, and 2:45 on the 31st. On the 28th she reaches her greatest brilliancy, and is very conspicuous.

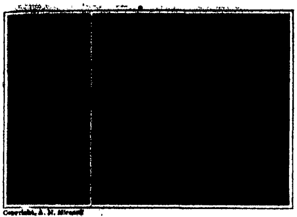
Mars is an evening star in Taurus, but is too near the sun to be seen under ordinary circumstances.

Jupiter is in Leo, and comes to the meridian at 7 P. M. in the middle of the month On the 31st he is in quadrature east of the sun. Saturn is also in Leo and souths about half an hour later than Jupiter. Throughout the month we still see the dark side of his rings, illuminated only by light transmitted through the interstices in the rings, and by the feebler amount reflected from the planet itself, as explained in our article of last month.

Uranus is in Aquarius and a morning star. He is in quadrature on the 31st, and crosses the meridian at six in the morning. Neptune is also in quadrature, on the opposite side of the sun, on the 1st. He is in Cancer and is observable (telescopically, of course), in the early evening.

The moon is new at 4 P. M. on the 7th, in her first quarter at 10 A. M. on the 14th, full at 8 P. M. on the 21st, and in her last quarter at 5 P. M. on the 29th. She is nearest the earth on the 11th, and farthest away on the 27th. While she makes her monthly circuit she passes Uranus on the 2nd, Venus on the 5th, Mercury on the 7th, Mars on the 8th, Neptune on the 13th, Jupiter on the 15th, Saturn on the 16th, and Uranus again on the 29th.

Princeton University Observatory,
April 17, 1921.



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Using three rope-gripping members and a suspended seat, and a near view of two of the rope-climbing stirrups

A Pocket Stairway for Climbing Ropes

WHAT amounts to a pocket stairway for climbing ropes has been developed by a Frenchman, M Paul Cans, and demonstrated by him with gratifying success. As efficient as this device is, its simplicity is undoubtedly the most surprising feature Indeed, it is one of those devices which, when studied by us for the first time, call for the irrepressible exclamation—"Why didn't we think of that before!"

It will be noted by studying the accompanying illustration that the device consists of a stirrup for each foot, which is hinged to a lever terminating in a ring which, in turn, is pivoted to the framework connecting two fixed rings. The rope passes through all three rings. Obviously, when the stirrups are pressed down, the center or pivoted ring grips the rope firmly, but when the stirrups are raised the center ring is in alinement with the fixed rings and the rope is released

Now then, to climb a rope it is merely necessary to push on the first stirrup which is locked on the rope, while the second stirrup is released and slid upward, whereupon the second stirrup is pushed down, locking on the rope while the first stirrup is raised and released so as to be slid upward, and so on. Rapid progress can be made with this equipment To slide down, it is merely necessary to raise the stirrups and the rope slides through the rings

By using a third device from which the stirrup has been removed and in its place a suitable rig for a seat is used, it is possible for one to climb a rope and rest at any point without effort, since the weight pulls down on the pivoted lever and grips the rope, thus resting the feet.

Taking a Cast from a Living Model

SOME remarkable results in the way of faithful casts from living models have been obtained by the Belgian sculptor, Pierre de Zoette, by a simple method which he has devised. The face of the model is coated with a suitable grease, after which plaster of paris is applied. Provision is made so that the model may breathe, for the casting process lasts some eight minutes or more. Furthermore, a fine wire is placed in the plaster of paris mixture. After the plaster has hardened, the fine wire is carefully pulled up so as to cut the plaster mold in half to facilitate its removal

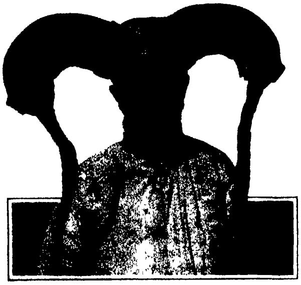
This mold is, of course, a "negative" To form a "positive" the mold is assembled and the breathing hole plugged up, after which plaster of paris is poured in and allowed to set. Upon removing both halves of the mold a remarkable cast is obtained, which, after slight touches here and there to remove small flaws in the casting operations, is a photographically correct reproduction of the head of the model

Copyright, Keystone View Co.

Removing part of the plaster cast made with a living model in order to obtain a strikingly faithful reproduction

French Industrial Reconstruction

A RECENT report from the office of the American commercial attaché in Paris states that of the 4,241 industrial establishments in devastated regions of France, 3,239, or approximately 76.2 per cent, reported on October 1 that they had resumed operations either in whole or in part In 1914 the total number of workers employed was 773,630, and on October 1, 1920, it is reported that the number employed in those establishments was 435,664, or about 44.6 per cent of the prewar personnel. It is noted that in the Lille regions 87.8 per cent of the industrial establishments have resumed operations, in the Department of the Ardennes 83.9 per cent, in the Department of Meurthe et Moselle 83.1 per cent, in the Department of the Nord 80.5 per cent, while in the Departments of Pas-de-Calais and the Vosges, the industrial establishments that had resumed operations were 74.4 and 73.1 per cent. respectively.



Remarkable head-dress of a Mongolian duchess

Speaking of Odd Head-Dress

OUR engineer readers have an interesting problem on their hands in deciding just what form of reinforcing this Mongolian lady employs for her head dress At any rate this photograph was secured by Mrs R Chapman Andrews, wife of the Associate Curator of Mammals of the Museum of Natural History of New York City, while on a recent trip through China The head-dress is typical of Mongolian nobility, and it is interesting to learn that our lady is a Mongolian duchess. Further proof of her social rank is to be found in the two red spots on her cheeks below the eyes

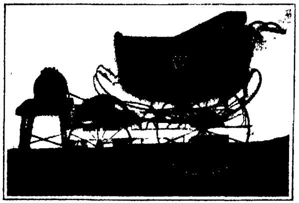
Electric Light from Waste Pipe Flow

AN ingenious and, withal, economical Frenchman, M. E. Colardeau, recently drew attention at a meeting of the Academy of Sciences to the many sources of energy which are wasted daily If these were utilized the community would be saved many millions yearly

As a concrete case he cited the way in which water is allowed to run out of the ordinary kitchen tap without its force being utilized. If the water flows, as is usual, from a cistern five meters above and at the rate of one liter per second, this flow provides sufficient power to keep charged accumulators necessary for the lighting of 20 lamps of 10 to 50 c p each.

In the country, where municipal water supplies of considerable pressure are absent, the scheme could also be put into practice, water being first pumped into a cistern by windpower, the same water being used continuously and drawn up from a reserve supply situated in the cellar.

M. Colardeau lights his own house in this way at Les Perreux, the apparatus he uses being contained in a box measuring 1 ft. by 2 ft. by 2 ft. The idea appears to be worthy of investigation



Using an alternating current motor to drive the perambulator motor for recharging storage battery during idle moments

When the Electric Motor Pushes the Baby Carriage

SOME day, when our statistical editor gets around to it, we are going to work up an interesting comparison showing how much horsepower is expended in the course of one year by fond parents pushing their offspring about the face of the globe, as compared with the total mechanical horsepower produced in the same period In the meantime—and despite the awkwardness of not having exact figures at hand—we venture to present the electrically driven perambulator which has made its appearance in England This little vehicle has been designed to relieve the parents of some of the hard work of pushing their babies about, especially up steep grades We are told that the English perambulator de luxe is provided with a 1/13 horsepower electric motor and a 6 volt 80-ampere-hour storage battery The motor drives the front wheels of the perambulator through a double reduction chain and sprocket drive The battery is suspended at the rear and quite close to the ground By driving the motor with another motor operating on any lighting current, even alternating current, the battery may be recharged in idle moments, as shown in the above illustration A heavy wooden frame placed below the perambulator springs serves to carry the storage battery and the electric motor The slow speed at which perambulators are driven makes the 1/13 horsepower sufficiently powerful for the work in hand, even on the steepest grades, it is reported

Inserting New Sections in a Stone Pillar

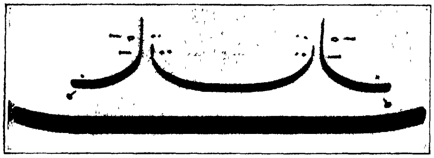
THE accompanying illustration is of interest in that it depicts the method employed in removing defective sections and inserting new sections in large stone pillars Clamps are placed about the upper section and a jack is inserted so as to raise it enough to permit of removing the defective section The good section is then swung into position by means of a block and tackle, and the upper section is released until it finally rests firmly on the new section

Copyright, Ewing Galloway

Jacking up the upper section of a pillar and swinging new section into place with block and tackle

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Laminated wood bumper for automobiles, and springs which serve as mountings

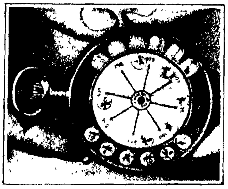
Laminated Wood for the Automobile Bumper

AMONG the latest developments in automotive engineering is a laminated wood bumper which, by replacing metal with wood in the bumper bar, embodies many desirable new factors

As a matter of fact, wood has been largely overlooked in the automotive industry chiefly because of the fact that automobile engineers themselves have concentrated their study almost wholly upon certain metals and alloys The use of wood in place of metal on a major scale actually dates from the airplane work during the war when a lighter substitute of equal strength was required Tests made then surprised many an engineer For instance, few realized that, weight for weight, wood is actually greater in tensile strength than steel and other metals Approximate values for static bending are represented by mild steel, 7½, aluminum alloy, 10, carbon spring steel, tempered, 17½, birch or hickory, 20 Only heat treated chrome nickel steel shows a greater value, 26½

Similarly in elasticity—the "give" so necessary in materials subject to impact—wood shows a notable superiority In stiffness—the opposite to elasticity—approximate comparisons are. Steel, 29 to 31, aluminum or bronze alloys, 9 to 14, hickory and birch, ⅛ to 1 8/10, which gives by far the greatest absorption of shock, to wood The time element is also distinctly in favor of wood, as it requires a measurably longer time to rupture wood

All of which leads up to wood bumpers for automobiles, which have now made their appearance The light weight of these devices reduces the overhang load fore and aft, making for easy riding The new wood bumpers are built up of laminated wood, in which the factor of non parallel fibers or "grains" adds greatly to the homogeneous quality Thin sheets of carefully selected wood, in a single operation, are glued together under high pressure into a permanent unit and shape, after which several coats of special airplane propeller varnish are applied



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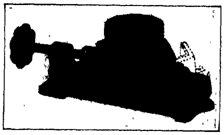
A miniature race track with twelve "horses" that may be carried in the pocket

A Piston Vise with a Firm but Harmless Grip

BY using a new piston vise recently introduced by a New York manufacturer, it is possible to hold any round or irregularly shaped work without the danger of distorting or marring it The jaws of this vise have four points of contact and it is claimed that this arrangement equalizes the tension and prevents distortion In order to protect the piston the jaws are lined with lead Through the fine thread screw pressure is gradually applied and the handle can be easily turned to any degree One of the vise jaws is movable so as to receive larger work than usually handled Triangular wood blocks attached firmly to the V-jaws make it possible to use the device as a parallel jaw vise.



A vise that holds the piston or other work firmly in place

A Lathe for Peeling Oranges

DOWN in Havana they have an ingenious method of peeling oranges which never fails to amuse the foreign visitor to the Cuban city Street venders selling oranges offer to peel the fruit This they do by placing the orange in the lathe-like device shown in the accompanying illustration, and then turn the handle until a cutter removes practically all the skin except at the two tips which have served to hold the orange in place The skin comes off in one long peel, as shown, as the crank is turned The cutter must be frequently resharpened

A Race Track for the Vest Pocket

FROM Germany comes the ingenious game made in the form of a watch and depicted in the accompanying illustration In truth, this is a miniature race track which is operated by pressing down the button in the upper right-hand corner "Horses" numbering from one to twelve are kept in little "stables" around the outside of the race track on which from one to twelve "horses" can run according to the number of persons playing When the button is pressed, the dial in the center spins around, taking the "horses" with it. The first "horse" at the finish post is the winner.

A Machine that Straightens Bent Spikes

A MACHINE for the purpose of reclaiming bent track spikes has recently been developed Such a machine is particularly useful wherever trackage is used and especially where trackage is constantly shifted, such as in quarries, and so forth

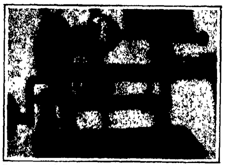
The old method of straightening bent spikes by hand was both dangerous and expensive and a very large percentage of the badly bent spikes had to be scrapped, as it took too much time and was exceedingly dangerous to workmen The machine will straighten a spike that is bent and twisted at nearly right angles, and it also eliminates the old and costly method of handling and shipping to central points and then resorting The machine weighs less than 70 pounds and can easily be taken to the job by the section men or bridge gang and all bent spikes be put back into service again By putting the usable spikes back into service it reduces new spike requisitions and also keeps the scrap bin at the central points clear of usable spikes.

The spike-straightening machine is made of electric steel casting, heat treated, giving it strength, and the wearing parts are case hardened The spikes are squeezed, thereby eliminating wear in the grooves.

This machine serves to bend the bent spikes back to their proper shape for further use

Better Fruit Packing with Less Work

AN "automatic" system for packing and wrapping fruit with all the advantages of the prevailing individual wrap and some others has been introduced on the Pacific coast. In fruit industries where highly-skilled and highly-paid fruit packers have been regarded as a necessity heretofore, the new method is one of the most talked-of subjects at this time In one case, its introduction actually led to a strike of Chinese packers, who saw the high wages they had been earning slipping away from them. The new wrapping and packing system not only can quickly be adapted to inexperienced help, even children—it can be learned in a day—but it is considerably less expensive in materials.



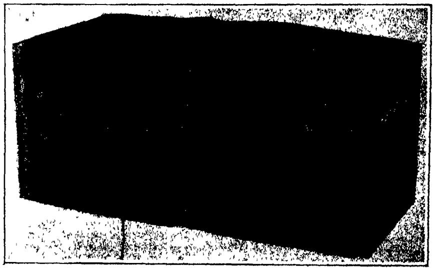
Copyright, Kadel & Herbert

A few turns of the crank serves to remove all the skin from an orange

The new automatic system is known as the Sykes It was devised by George Sykes Its basis is the so-called separator wrap This is a flat, pliable piece of cardboard the size of the apple box or other fruit container being used At regular intervals on this cardboard there are radial cuts, the number of those varying with the sized fruit being packed. Thus the separator wrap used for apples, pears and other fruits and vegetables with a diameter of 3 inches to 3¾ inches has fourteen radial cuts At these cuts the cardboard is slightly cupped

The packer puts a wrap, sometimes called a "form," in the bottom of the box. He places an apple, stem down, on each cut or cup. Next, he places another wrap on top of this first layer or tier, reversing it so that the cuts or cups are not above the apples in the first tier He goes on in this manner until he reaches the top of the box, when he takes a board slightly smaller than the inside of the box, places it on top of the packed fruit, and with evenly

(*Continued on page 378*)



Side and top view, with several oranges removed, showing the new separator wrap method of packing

Tilting Grain Cars in All Directions to Empty Them

(*Continued from page 361*)

any reason halted on their way to the bins aloft. Without this backstop the weight on one side of the elevator head and lack of weight on the other side would cause the elevator belt to reverse its action when the power went off This is a common experience in other elevators and invariably causes several hours' delay

Government regulations require that after weighing each car of grain the weights shall be removed from the scale to test the latter. To lessen the time consumed in meeting this requirement, a lever has been provided which lifts the weights free of the scales by a single movement of one arm.

These are but a few of the outstanding features of this structure which illustrates the last word in elevator construction.

Looking Backward 4,000 Years

(*Continued from page 366*)

who could afford it purchased such models to be piled around his coffin in his tomb and today every museum possesses a few. What was important in this case was the fact that Mehenkwetre was a person of great wealth who, to duplicate the bountiful existence he had led in this world, had supplied himself with a larger series of such models than has ever before survived to modern times This survival we owe to the fact that his tomb architect had adhered to the archaic idea of the "serdab" and that this crypt had escaped the plundering of his burial chamber

Each group or model was removed with extreme care, photographed, a minute chart made, and every figure numbered. The reader may wonder why so much labor should be spent in the cramped little chamber where one's head banged against the ceiling every time one forgot and stood upright The answer is that no one can foretell what questions may arise in the minds of other students who did not have the luck to see the models in place For example, it has been suggested that the boats sailing upstream should be placed with their prows to the south and those rowing down with their prows to the north The photographs and the plan make it possible to reconstruct the position of every boat and the archaeologist at home will be able to answer the question to his own satisfaction

Curious injuries to some of the figures suggest a clandestine visit of some children of the family some 4,000 years ago, who appear to have sneaked in and played with the figures and burned one of the masts and lost one of the arms of the fisherman At last all the trayloads of models were safely under lock and key. All had to be photographed, for one-half of the find had to go to the Cairo Museum, while the other half went to the Museum in New York There are twenty-four groups in all They are pictures of daily life and only three have anything to do with the tomb or with the funeral. On either side of the chamber were statues of girls in fancifully colored garments bringing offerings to the tomb, wine, meats and bread, and each with a live duck in her hand." They are half life-size and are carved from wood. One group of four figures makes the other funeral group All of the rest of the models pictured the life which Mehenkwetre lived here and which he expected to live in the hereafter. The most imposing of all is the noble counting his cattle, which is unfortunately in Cairo, but is shown in one of our illustrations The slaughter house, the granary, the bakery, the brewery, the textile mill, the carpenter shop, are all to be found in these fascinating little groups. Two model gardens were found, one with a little copper pool to hold water and surrounded by fruit trees.

A great man like Mehenkywetre would be required to journey up and down the river, so he had vessels for business and vessels for pleasure and half of the models found are of boats and were typical of the Nile river craft 4,000 years ago. The models of boats are about 4 feet long and have crews of 12 to 18 sailors outside of officers A sort of humorous fidelity inspired the maker of these ships In the cabin of one sits a little steward beside a bunk under which are tucked two little round-topped traveling "hair" trunks very much like those of a generation ago

A great man like Mehenkywetre come to New York will find the models in one of the Egyptian rooms on the Fifth Avenue side of the Metropolitan Museum of Art Space does not allow us to show many of the models, but a much fuller article with many additional illustrations will be found in the SCIENTIFIC AMERICAN MONTHLY for June The text is in the exact words of two of the members of the Expedition and it reads like a fairy tale.

Fuel Conservation Opinions—I

(*Continued from page 368*)

charge The principal element of cost in steam plant operation is an operating charge If manufacturing developments take place near water-power developments, power costs should be appreciably lower, and the gain substantially greater than the present condition of employing long transmission lines Water power will certainly supplant steam power in the not distant future, states this company, but to this we must add the statements of others to the effect that water power can only supplant steam in regions well within the range of economical distribution Where water power is not at hand, there can be no water power developments Furthermore, many fuel authorities are agreed that water power is not a universal project that can be considered in general terms each and every development should be considered by itself.

Bringing the Fuel to the Factory

During the days of war and the abnormal business activity following the Armistice and persisting up till a few months ago, many consumers of fuel experienced no end of difficulty in getting their fuel supply from the mine to the factory door But with the present business depression and the general slowing up of railroad traffic, there is little or no real difficulty in this direction

However things may be at this writing, it is certain that business must soon revive to full blast, so to speak, in which case large consumers of fuel will again experience difficulty in transportation By the same token the suggestion of the Vice President of the Laclede Gas Light Company—that a working out of a scheme which would permit more regular mining throughout the year would help out transportation more than any one thing—might well be put into operation, even now

The burden of transporting fuel can be lightened in a large measure if certain industrial districts will use the low grade fuels available near their plants instead of importing a higher grade supply from a distance, states a fuel authority who specializes in automatic stoking machinery. Until recently this importing of better fuel has been imperative in many cases because the stoking equipment then on the market would not give high capacities or flexibility with the lower grade fuels However, there are stokers available today that permit of using these low grade fuels; and, once these stokers are employed in a big way, there will be a reduction in the unnecessary coal-carrying burden now borne by the railroads and lake boats.

The American Engineering Company of Philadelphia states that in its opinion there would be an undoubted advantage

(*Continued on page 377*)

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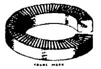

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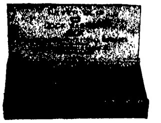

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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Electrical Devices

FUSE—G E Conrad, Box 55 Stillwater, Minn Among the objects of the invention is to provide a construction which will permit of a refill without the necessity of taking the body of the fuse apart by simply loosening a pair of retaining screws A further object is the provision of a fuse having means by which the filler, of soft metal construction may be protected yet readily exposed to view so that its condition may be instantly determined without the necessity of test

SEALING DEVICE A W Wildner, Calle Maipu 671, Buenos Aires Argentina The invention relates to a device intended for office use and consists of a seal for stamping seals of sealing wax in combination with an electric heater The sealing wax is conveniently prepared in the form of tablets the heat from the electric coils gradually softening the wax to a degree at which it will take the impression of the seal

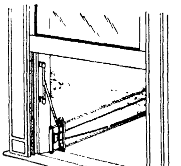
Of Interest to Farmers

MEANS AND METHODS FOR BUILDING SILOS—F Thiel, 108 William St, Hammond Ind An object of the invention is to provide means for building silos by the use of which the expense of erecting the ordinary scaffolding of lumber is obviated as well as the work and expense of again removing the scaffolding A further object is to provide a series of portable hangers or scaffold units that are raised as the structure is progressively built up and which may be lowered after the work is complete, and used over and over again

DISK PLOW AND THE LIKE—S Yuasa, c/o E T Nielson, Prospect Rd, Cupertino, Cal It is the purpose of the invention to provide an auxiliary disk mounted upon the frame which carries the plow disk in such manner that it may be manipulated to assume various horizontal angular positions relative to the frame and thus realize a practical advantage in turning a furrow close to fences at fence corners and other like places

Of General Interest

COMPENSATING SAFETY CLOTHESLINE HANGER—A Heyman and C C Vervoort 142 Newell St, Brooklyn, N Y The invention relates particularly to a type of hanger which may be withdrawn within a window so that the clothes may be conveniently hung thereon Among the objects is to provide a clothesline support of simple and rugged construction which is adapted to be positioned outside of the window when not in use, the support may be readily adjusted to windows of different sizes, and is arranged to prevent the possibility of collapsing when in use



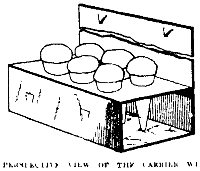
VIEW SHOWING THE APPLICATION OF HANGER TO A WINDOW

STRAINER—J Daniels, 329 E 14th St New York, N Y The invention relates more particularly to a detachable strainer for coffee pots, the device being so constructed that it in no way prevents the closing of the lid of the pot A further object is to provide a device which is simple and so constructed as to lie in proper position with regard to the spout, and requires a certain amount of force to effect a displacement, thus preventing accidental movement

WARDROBE FIXTURE—B Brager, 84 5th Ave New York, N Y An object of the invention is to provide a rail member having an integral downwardly projecting handle for the manipulation thereof in any direction with respect to a fixed channel member A further object is to provide a support for garments or the like provided with facilities for supporting trousers, skirts, etc, in the best possible position

SAFETY DEVICE FOR WELLS—J F McDowell, 2015 Laurel St, Shreveport, La The invention has for its object to provide a device which may be arranged at the top of the well casing, about the drill stem or other tools for preventing downward movement of the tools during the raising thereof, the said means having means for gripping the stem when it moves downwardly and for releasing the stem when it moves upwardly

CONFECTION CONE CARRIER—J J Boynes, Abercrombie N D This invention relates to carriers formed of cardboard for carrying cones containing ice cream, the object being to provide a carrier which effectively supports a plurality of cones without the necessity of providing an additional means for supporting the carrier during such operation The invention allows of the formation of such carrier with a minimum quantity of cardboard, at the same time providing a cover as well as a support for the ice cream cones



A PERSPECTIVE VIEW OF THE CARRIER WITH LID BROKEN AWAY

RULE HOLDER—C R D Kane 524 2nd St, Hoquiam Wash This invention relates more particularly to an inexpensive device whereby folding rules may be effectually held in rule pockets of overalls and work garments against danger of accidental displacement, and in such way as to permit of ready removal of the rule when desired The device may be readily secured in place

CASEMENT WINDOW—L Lane, P O Box 1066, Habana, Cuba The invention more particularly relates to a metal window frame and sash A specific object is to provide an embodiment that may be produced from few elements of simple form and resulting in a strong and weather tight casement by the ordinary methods of manufacture employed in the quantity production of metal sashes and window frames

OILING DEVICE—A Blumenthal c/o Bronx Novelty Works, 3476 3rd Ave, Bronx N Y The object of the invention is to provide an oiling device arranged for thoroughly rubbing oil or similar liquids on wooden floors and the like Another object is to prevent scratching or other injury to the surface treated and to permit of conveniently oiling a large surface with a single charge of oil and without requiring much physical exertion on the part of the operator

BOX FOR ARTICLES OF PERFUMERY—J A L Dumons 171 Rue Ordener, Paris France The invention has for its object the provision of a box designed to contain and to retain firmly during use various articles of perfumery such as shaving soaps, dentifrice soaps, blocks of solidified brilliantine, compressed rice powder, etc The device is arranged in such manner as to collect the excess lather and water, or the material which runs over the edge at the same time insuring that the product is firmly held

Hardware and Tools

DOOR HANGER AND ADJUSTER—E G Morin, 4001 20th St, San Francisco, Cal The primary object of the invention is to provide a hanger which is simple, inexpensive, reliable, practically noiseless, capable of being readily and easily adjusted and which may be easily assembled and fitted without necessitating any change in the door frame or wall construction or the provision of special wall and door frame construction

FOLDING SHUTTER—M D Lafuente, Calle Maipu 671, Buenos Aires, Argentina. This invention relates to a metallic shutter, substantially characterized by the particular manner in which the parts which constitute the structure, are folded and lodged within a recess or cavity formed at one or both sides of the frame, according to whether the shutter consists of one or of two doors or parts

Heating and Lighting

RADIATOR PLUG—C J Brown, Box 875, Hamilton, Texas The object is to provide a plug for sealing the tubes of radiators with a fluid tight joint thus permitting the usual sealing caps to be dispensed with. The device comprises a spherical body of resilient material, caps disposed at opposite sides of the body a bolt passing through the body and caps and a clamping nut threaded on the bolt, the caps having their edges serrated and inturned for penetrating engagement with the body to prevent rotation

Machines and Mechanical Devices

PISTON RING—J Miller, 208 Central Ave Albany N. Y This invention relates to a sectionalized piston ring having similar sections oppositely disposed and each tapering uniformly from the middle to both ends, whereby uniform tension is obtained and an effective fit produced between the piston ring and cylinder, the meeting faces of the rings having shallow grooves extending half way around each section, such grooves insuring the maintenance of a film of oil between the sections

AIR COMPRESSOR—E A Golle, Grand Beach, Mich The invention more particularly relates to compressors of the rotary type. The prime object is to provide a device in which the air may be compressed with greater efficiency than is capable of machines at present in use A further object is to provide a device which is simple in both construction and operation

Musical Devices

PHONOGRAPH SOUND BOARD—W A Scott, Box 78, Parkwood, Oreg The object of this invention is to provide a device wherein the volume of tone is increased while the quality of the instrument is rendered with clearness, and in reproducing the voice it also adds to the distinctness of the words being spoken, the sound board being combined with an amplifier and forming a part thereof

STOP FOR PHONOGRAPHS—R Bartolomeh, 240 W 24th St, New York, N Y The invention relates to a stop which will be actuated automatically upon the reproducer reaching the last groove of the record By this device it will not be necessary to insure the stoppage of the turn table, even though the record varies with respect to the number of convolutions of the spiral groove in its face

Prime Movers and Their Accessories

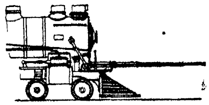
CRANK-CASE BREATHER FOR INTERNAL COMBUSTION ENGINES—H C Miller, Genoa, Neb An object of the invention is to provide means for supplying the crank case with lubricating oil required by the engine and prevent undue compression within the crank case, and the entry of dust and grit into the crank case, and to retain entering dust and grit against entrance of the crank case and provide means whereby the same may be readily cleaned out or removed as required

INTERNAL COMBUSTION ENGINE—C. L MacVey, c/o Foster's Jewelry Store, Monroe, La An important object of the invention is to provide a construction of rotary valve by use of which the four functions of intake, compression, firing and exhaust may be performed upon one complete revolution of the valve A further object is to provide an engine having gravity operated means for lubricating the rotary valve, and for feeding the used oil from the valve to the interior of the cylinder for lubricating the piston, the spent oil being subsequently exhausted from the cylinder.

AUTOMATIC FUEL FEEDING DEVICE.—A S King, c/o First State Bank, Pawnee City, Neb The invention relates to devices for automatically feeding the liquid fuel from the storage tank to the carburetor of an internal combustion engine A further object is to provide a device which is simple in construction and liable to easily get out of order and in which the feeding of the fuel is rendered positive through the action of the engine.

Railways and Their Accessories

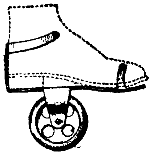
MEANS FOR DRIVING LIVE STOCK FROM RAILROAD TRACKS.—W. A. Williams, 601 E Cheves St., Florence, S. C. The object of the invention is to provide a series of telescoping tubes at the front of a locomotive with a view to allow water or steam to pass out of the outermost tube in a stream a distance along the track to drive the cattle off and thus avoid the killing of such live stock Another object is to enable the engineer to readily apply such means and to permit of its being normally folded to take up very little room



A SIDE VIEW OF THE DEVICE APPLIED IN EXTENDED POSITION

Pertaining to Recreation

ROLLER SKATE.—B. F Spencer, Box 218, Los Angeles, Cal The purpose of this invention is to provide a skate in which the foot plate and the clamping plates as well as the supporting brackets of the wheel are formed from a single sheet of metal, thus permitting the stamping of the same and thereby materially reducing the cost of manufacture.



A VIEW SHOWING THE SKATE APPLIED

Pertaining to Vehicles

TIRE—O. Buse, 824 Second Place, Plainfield, N. J An object of the invention is to provide a tire having projections which are made hollow and in which cementitious inserts are embedded securely anchored in the tire and located flush with the outer face of the tire so that this material, when hardened, forms an artificial stone insert which constitutes a permanent fixed part of the tire.

REFLECTOR.—E. Zimmermann, Jr., 187 Lincoln St, Hudson Heights P. O, N. J. The invention relates more particularly to reflectors for automobile headlights, an object of the invention being to provide a reflector which can be inserted in an ordinary headlight casing without altering the construction, and which will increase the area and power of the illumination and at the same time diffuse or soften the light so as to prevent glare.

Designs

DESIGN FOR A PEN-HOLDING ATTACHMENT FOR INK BOTTLES.—J. J. Harper, 5512 Walnut St., Shadyside, Pittsburgh, Pa.

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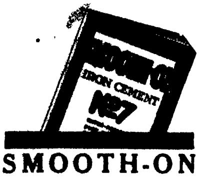

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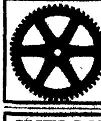

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MOTORS
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$22.75 Each
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Fuel Conservation Opinions—I

(Continued from page 375)

for the coal operator and for transportation if fuel were allocated to particular districts and the users were required to estimate their annual needs. It is customary at the present time for all users to accumulate a maximum surplus prior to winter conditions of transportation. While there are a number of disadvantages against storage of coal in spring, which coal is to be used the following winter, due to deterioration and so on, and a further disadvantage of probable lower costs later, much could be done in this direction to relieve the intensified demand in the late fall.

From the railroad standpoint, Mr. A. T. Hardin, Vice President of the New York Central Lines, states that under ordinary conditions no particular trouble is experienced in the transportation of fuel. Where the New York Central Lines do not directly reach the mines, they are reached by intermediate connections and the haul to junctions with their lines is comparatively short. It is customary during the summer months when the coal market is dull to secure a surplus supply of coal which is stored at points on the line that are most remote from the coal fields, to be used during periods when there might be interruptions to traffic. A number of industrial plants follow the same course. During the past five years there have been so many unusual conditions to contend with that the distribution of commercial coal, and to some extent the railroad coal, has been irregular, but under normal conditions there is no difficulty in distributing coal regularly.

Also typical of railroad opinion is the remark of Mr. Bean, Mechanical Assistant to the President of the New York, New Haven & Hartford Railroad, to the effect that it appears reasonable to believe that railroads could very largely offset coal distribution difficulties if more of the users of coal would carry a reasonable amount in stock—accumulating said stock during periods when demands for coal are the least.

In an early issue this fuel symposium will be concluded, with particular emphasis on the fuel conservation phase and the suggestions bearing on new fuels and future sources of power.

Cold Vulcanization of Rubber

(Continued from page 369)

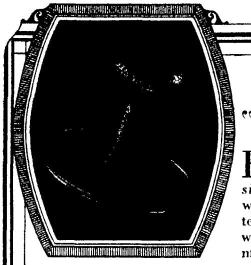
corporate delicate organic dyes, etc., where before only coarse inorganic pigments were allowable, delicate dyes having been destroyed by the combined action of the heat and the sulfur. Beautiful fabrics and wall coverings in the new rubber have been produced. As regards physical properties it is quite equal to the product of the old hot process, and superior to that of the old cold process. It is also possible to work up organic matter and fiber in the mass of the rubber, securing toughness and the hard wearing properties suitable for rubber soles, pneumatic tires, etc.

By the new process it is also possible to vulcanize rubber in solution, a feat not hitherto possible. If a solution of rubber in any of the usual solvents, benzine, toluene, etc., be treated alternately with sulfur dioxide and sulfuretted hydrogen, the thin solution rapidly thickens and forms a jelly which can be put to many uses, it being possible to coat fabric in this way with vulcanized rubber in one process. Previously the fabric was coated with rubber in solution, the solvent evaporated, and the fabric then vulcanised.

The great advantages which render the Peachey process of fundamental importance are:

(1) No heat is required, and to a great extent mechanical pressure may be dispensed with.

(2) It is a true sulfur vulcanisation like the original Goodyear process. Sulfur chloride treatment is not.



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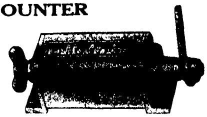
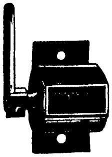
Veeder
COUNTER

The large Set Back Revolution Counter at right is less than ½ actual size. The small Revolution Counter below is shown nearly full size





The Set-Back Revolution Counter above records the output of the larger machines where the revolution of a shaft registers an operation. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, according to purpose. Price, with four figures, as illustrated, $10.00 (subject to discount)

The Small Revolution Counter at left records the output of smaller machines where a shaft revolution indicates an operation. Though small, this counter is very durable, its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00

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Hartford, Conn.

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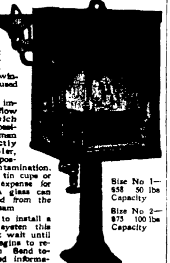
Plan NOW to install a water cooler system this summer—don't wait until hot weather begins to reduce production Send today for detailed information and quotations.



Size No 1—$58 50 lbs Capacity

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SQUARE WATER COOLER

(3) It is rapid and cheap—the two gases can be produced on a large scale.

(4) Cheap and highly durable filling materials such as leather waste, shoddy, sawdust, etc, may be used which are destroyed by the hot process. Coal-tar and natural dyes may be incorporated in the mass, in lieu of coarse mineral pigments, with the production of delicate tints and shades hitherto unobtainable

The process has been extensively tried out on a laboratory scale and is in process of transference to factory practice No difficulties are foreseen in the transference since the simplicity of the process makes large scale working quite as easy as small scale

Machine-Made Window Glass

(Continued from page 370)

the glass plastic so that it will bend at right angles in running over the roll and out to the flattening table and lehr, the growing sheet runs the gauntlet of a series of gas jets

From the flattening table the lengthening sheet of glass is carried mechanically to the lehr, and when reaching this annealing furnace the bait is broken free of the glass and lifted out through an opening in the top of the lehr At the same time, clamp bars grip the sheet and force it onward, and this operation continues the process of extracting the glass from the tank without further recourse to the bait The conveyor within the lehr consists of a series of power-driven rolls, placed transversely every 12 inches throughout the entire length of this furnace These rolls insure a uniform drawing impulse, and should a sheet of glass break in transit through the lehr the rolls will carry the pieces right along to the cutting table at the farther end of the annealing chamber At the lehr exit the issuing glass runs under cutters, placed at each side of the sheet, which automatically trim the edges, and the uneven scrap drops into a hopper placed beneath the table The hopper discharges on to a conveyor, which bears the scrap glass, known as cullet, to a crusher in the batch room, from whence it is fed from time to time into the melting tank

Should a drawing machine be stopped for any reason, it is set going again by the following procedure. First, the elevating gear is reversed so as to allow the bait to pass through the apparatus and to descend into the tank until it is in contact with the purified molten glass in the drawing receptacle. Next, with this done, the machine is started in the opposite and normal direction, the bait is raised, and the sequence of the extraction of the sticky, tenacious material goes on, as described, uninterruptedly for days From the time the glass leaves the tank, in the case of "single-strength' sheets, until it is cut upon coming out of the lehr is a matter of only 40 minutes

It will be readily grasped that the thicker and the wider the sheet the more deliberately will the bait be moved in effecting the initial extraction of the syrupy glass, and this pace is thereafter maintained so that sufficient material will continue to follow from the tank so long as the machine is running. The speed is varied to suit the different thicknesses or 'strengths" of the window glass being made, and the rate of travel is subject to perfect control Herein arises one of the niceties of the industry, for the viscosity of the glass in the molten state likewise influences the rapidity with which it can be manipulated to insure prescribed results The temperature of the glass and the composition of the mixture affect the viscosity

In order to obtain satisfactory functioning, in view of the peculiar nature of glass and the temperature limits within which it can be worked, the engineers have been required to make certain of smoothness of operation and an absence of any vibration that might cause the glass to fracture or tear loose at a critical stage Jarring of the bait would surely lead to trouble, for the molten glass would cling unevenly to the bar and therefore not trail after it in a manner to form an acceptable sheet Similarly, when once the bait has fulfilled its duty, and further extraction proceeds automatically, any sudden tug or one-sided pull over the roll would be apt to disrupt or to disturb harmfully the uniform upward flow of the unstable substance The fact that these untoward happenings have been cunningly guarded against to an astonishing degree is the best evidence of the thought and skill that has gone into the evolution of these remarkable glass-making machines

At Charleston sheets of glass 58 inches wide and 3/16 of an inch thick are made regularly, and improvements are in hand which will permit the drawing of sheets 82 inches wide It is reported that the operation of the equipment at the West Virginia plant has been so carefully regulated that the edge waste has been cut down more than 50 per cent This means, of course, that a greater quantity of marketable glass is secured during a working period Efforts are being made, with promise of success, toward adapting the Libbey-Owens apparatus to the manufacture of wire glass

A belief has been fostered that hand-blown window glass is better than the machine made product principally because the repeated reheating of the hand-blown material anneals it more thoroughly This claim is now disputed, and it is said that by the process under discussion it is practicable to obtain a perfectly annealed glass of fine finish, uniform thickness, and flatness Apparatus of this type have been installed in Canada and Japan, and the intention is similarly to equip a large factory in Belgium So much for the expansion of a phase of the industry which has forged to the front despite much discouraging criticism But let us return to the operative cycle at the Charleston establishment

The sheets of glass, after they issue from the lehrs and are cut into convenient lengths, are trucked into the cutting room and delivered to the cutters, where they are subdivided into commercial sizes agreeably to orders Underneath the cutters' chip boxes runs a carrier that mechanically empties these receptacles and transports the waste to the main cullet conveyor which, in turn, delivers it to the crusher already mentioned It is not alone in the actual production of glass that steps have been taken to hold to a minimum the number of human workers. Wherever possible mechanical facilities have been pressed into service The plant has a yearly capacity of 2,500,000 boxes of glass

For instance, the box factory, which is at one end of the plant, with the hay storage adjoining, is equipped with box-making machines, and the containers, with the needful hay packing, are lifted and transported to the cutting rooms As they move along, the boxes are automatically tipped and sent down an incline to the packers From there, the shipments are taken away by electric trucks and shifted to the ground floor on hydraulic elevators where railway cars, under cover, are in waiting

According to the latest figures available, we manufacture annually about 9,500,000 boxes of window glass containing 50 square feet each, and approximately 60 per cent of this output is machine-made. More than $4,000,000 is invested in the factories engaged in this department of the glass industry.

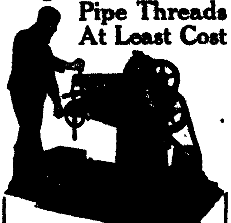
Better Fruit Packing with Less Work

(Continued from page 374)

distributed pressure pushes the packed fruit down and together. Then he adds another tier.

All the fruit now has paper loosely around it. The number of apples in the

Tight Accurate Pipe Threads At Least Cost



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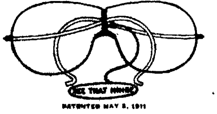

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box is equal to, and sometimes more than, those in a box packed by the individually-wrapped system. It is declared that there are thirty-two channels of ventilation leading to each center apple, and that the fruit consequently keeps well, better even than in the individual wrap When the dealer comes to display the fruit, he takes off the side of the box, and has an attractive display without the necessity of unwrapping and thereby destroying the pack

The system is said to be based on exact mathematical calculation, and fits to a given space as many round objects of the same weight and size as can be put there The structure is four complete circle arches of six objects around a center object, which is declared the strongest possible Experience indicates that the fruit carries as well as that packed by the old system

The great attraction of the Sykes system is its economies The recent increase in transportation rates has reduced the margin that Pacific producers work under, and the situation becomes easily conceivable in which several cents saved on packing would be of crucial importance The new "automatic" method on the labor side not only requires less skilled, and consequently less expensive help, but a smaller packing force In practice three packers using the separator wrap will equal the output of four using the individual wrap

On the material side, there is a saving on paper of one-half to two cents a box

Tomatoes, peaches, pears, apricots, oranges, lemons, and other fruits were commercially packed the past season by the new method An example of its capacity is pointed to in pears, one of the most difficult of fruits to pack There is a saying among fruit growers that it takes four years to make a good pear packer, under the individual wrap system Any inexperienced hand can be taught to pack pears by the separator wrap method in a few hours With this fruit, as with others, the packer uses two hands for actual packing There is no labor of fitting as with the old system

How to Tell Birch, Beech and Maple Apart

BIRCH, beech, and maple are very similar in appearance, and have approximately the same weight Hence it is comparatively easy to mistake one of them for another A method which anyone can use to distinguish them is suggested by the U S Forest Products Laboratory The method makes use of the relative width of the pores and medullary rays in the three woods

If the end grain of birch, beech, or maple is cut smooth with a sharp knife and examined with a hand lens, the pores will be seen as tiny holes distributed fairly evenly over the surface, and the medullary rays will appear as narrow lines of a different shade running at right angles to the growth rings

In beech some of the rays are very distinct even without a lens The large rays are fully twice as wide as the largest pores

In maple the rays are less distinct, and the largest are about the same width as the largest pores.

In birch the rays are very fine, invisible without a lens. The pores are several times larger than the rays, usually being visible to the unaided eye as minute holes on the end grain and as fine grooves on dressed faces of the board. The pores in birch are considerably larger than the pores in beech or maple.

The appearance of the medullary rays on a "quartered" surface is also distinctive. Here they appear in beech as distinct "flakes," the largest being between 1/16 and ⅛ inch in height when measured along the grain of the wood. In maple they are considerably smaller, rarely attaining a height of 1/16 inch. In birch they are comparatively inconspicuous.

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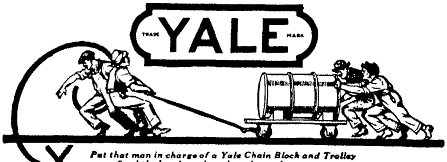

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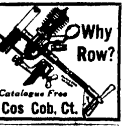

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NEW BOOKS, ETC.

A MANUAL OF CANNING AND PRESERVING. By Theodora M. Carrell. New York: E. P. Dutton and Company, 1919. 12mo.; 101 pp.

From the depths of a varied experience the author recovers for the housewife recipes and methods by which an opulent array of foods may be preserved in their original coloring, flavor, and nourishing qualities. Her instructions are precise, interesting, and complete; the cold pack method is of course included.

LIFE. A Study of the Means of Restoring Vital Energy and Prolonging Life. By Dr. Serge Voronoff. Translated by Evelyn Bostwick Voronoff. New York: E. P. Dutton and Company, 1920. 8vo.; 180 pp., 30 plates.

One by one old dreams come true. But we have discarded the devil, and our modern Faust will seek the operating table instead. The SCIENTIFIC AMERICAN MONTHLY for November recounted the experiments of the Austrian, Steinbach. Now, in this absorbing book Voronoff records his own successes in testicular and thyroid grafting, by means of which animals and men have been startlingly rejuvenated. His straightforward account makes plain both methods and results; he is confident that the surgery of the future will be the grafting of organs, tissues and glands, and that the ape will be the guardian of vital energy transmissible to man. The effects seem to be authenticated; what we do not yet know is how long they may be expected to last.

MATTER AND MOTION. By J. Clerk Maxwell, M.A. New York: The Macmillan Company, 1920. 12mo.; 163 pp., illustrated.

It is well that this little classic should appear in a reprint wherein its bearings on modern theories of relativity are pointed out in a lucid appendix by Sir Joseph Larmor. Maxwell had the faculty of crystal expression. In Matter and Motion he generalizes from the simple particle to complex physical systems and deals with the fundamental principles of dynamics. There is a fine portrait and a biographical sketch.

THE AMERICAN BOYS' HANDYBOOK OF CAMP-LORE AND WOODCRAFT. By Dan Beard. Philadelphia and London: J. B. Lippincott Company, 1920. 8vo.; 270 pp., 377 illustrations.

Dan Beard opens his duffel bag again for the delight of the outdoor boy; as usual, it contains big medicine—fires without matches, ways of laying fires for various purposes, little pointers that make for comfort in the camp, something about horses and saddles and dogs, and the expert wielding of the ax; directions, too, for laying out a council ground, and the ritual of the council fire. In the author's numerous pen and ink sketches are pictured most of the devices and stunts about which he writes.

MODERN EXPLOSIVES. By S. I. Levy, B.A. New York: Isaac Pitman and Sons, 1920. 12mo.; 109 pp., 11 illustrations.

The writer's connection with the British Department of Explosives during the war gave him unusual opportunities for studying comparative methods of manufacture in European countries, including Germany. While his meaty little book carries much objective knowledge relating to raw materials, the acids section, the preparation of high explosives, etc., it also brings out the interdependence of modern industry, surveys research and productive activity as a whole, and gives newly found basic principles in non-technical language.

DETAIL DESIGN OF MARINE SCREW PROPELLERS. By Douglas H. Jackson, M. I. Mar. E. New York: Isaac Pitman and Sons, 1920. 8vo.; 92 pp., illustrated.

In designing propellers it is a difficult matter to bring theory into harmony with concrete conditions. Mr. Jackson seeks to do this for the average student, who is apt to lose himself in the treatise of the expert. The text outlines accepted theories, treats very fully their practical applications, and describes manufacturing operations. With its many tables, cuts, and folding inserts it constitutes a good handbook for the student and the draughtsman-designer.

GOLD. Its Place in the Economy of Mankind. By Benjamin White. New York: Isaac Pitman and Sons, 12mo.; 128 pp.; illustrated.

The relation of gold to banking and exchange is of paramount interest. The author is a member of the Institute of Bankers and of the Royal Statistical and Royal Economic Societies; he gives us a concise account of the way in which gold assumed its value in these relationships, embracing the history of its production and uses. Its present production and prospects, world mintage, and the gold standard are presented and explained, with chapters on stocks, gold and the war, and industrial uses.

POLITICAL AND COMMERCIAL GEOLOGY AND THE WORLD'S MINERAL RESOURCES. J. E. Spurr, Editor. New York: McGraw-Hill Book Company, 1920. 8vo.; 562 pp.; maps and graphs.

Twenty-seven specialists who followed mineral problems closely during the war give us these studies of the commercial control of raw materials by different powers, and [illegible] the related questions of our domestic and foreign policies. The multiplication of humanity, with the fierce competition engendered, enters into the equation, while the metals are the basic element of it. Sentiment only follows expediency; the heart of Alsace-Lorraine is iron; the soul of Silesia, coal. The work would make America conscious of what Europe has long recognised: that, as natural resources dwindle, certain principles involving foreign trade awake and function; it is high time that we, too, awake to the facts and set ourselves wisely and energetically to meet them.

THE "WELLCOME" PHOTOGRAPHIC EXPOSURE RECORD AND DIARY, 1921. New York and London: Burroughs Wellcome & Company. 18mo.; 260 pp.; illustrated.

A little better each year, this pocket book with its cheery red cover holds much of interest to any camera man. Exposure commands the space to which its importance entitles it, and the ingenious calculator affixed to the back cover is, as always, a feature. Among newer phases dealt with in the brief articles are aerial photography, color work and telephotography.

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES. For Buyers and Sellers. New York: S. E. Hendricks Co., Inc., 1921. 4to., 2572 pp.

Charles Lamb divided mankind into those who borrow and those who lend. Today a juster classification would be those who buy and those who sell; but we are all buyers and sellers by turn. In whichever category you may find yourself at the moment, this trade register, rejuvenated every year, will give access to complete, reliable information as to producers, manufacturers, dealers and consumers. It has a classified trades section, a long list of trade names, brands, etc., and an alphabetical section. Any source of supply or demand, whether for raw material, finished article, or service, may be quickly found from the firm name, the general name of the product, or the trade name. The register is also in wide use for mailing lists, and is justly appreciated by the many factories, machine shops, mills, mines, railroads, and municipalities that use it.

LIBERTY MAP OF NEW EUROPE. New York: Funk & Wagnalls Company, 1920. 4½ feet wide by 3½ feet high.

In no way can the profound changes resulting from the war be better followed than from this *Literary Digest* map, which includes Africa. The State Department and the American Geographical Society have coöperated with some of our best map makers to produce a graphic guide to developments in Russia, France and Germany, shrunken Austria and circumscribed Turkey, the new Balkan alinements and the many other changes, are plainly shown. A complete index locates 12,000 towns, rivers, etc. It is such a map as no school, library or home should lack, and is obtainable either on durable map bond paper, folded and pouched, on map cloth, folded, or as a cloth-mounted wall map, on rollers.

THE NEW WORLD OF SCIENCE. Its Development During the War. Edited by Robert M. Yerkes, Chairman, Research Information Service, National Research Council. New York: The Century Company, 1920. 8vo.; 443 pp.; 21 plates.

"Can any good thing come out of"—Armageddon? One good thing, at least, did. War forced us to mobilise our scientific resources, not only in producing and surpassing German products upon which we had too long relied, but also in research that enabled us to locate hidden guns by sound, to meet poison gas with [illegible]-poisonous gas, to shoot better, fly better, and to find the secret mechanism of obscure disease and wage effective war against that. In this notable book, authorities tell the dramatic story of the rôles played by physical science, chemistry, engineering, and [illegible] the war, and set forth the way in [illegible] we shall turn our new knowledge to advancement in the arts of peace. A profound respect for pure science, the father of material comfort, safety and progress, is instilled in the mind of the fortunate reader.

IN THIS ISSUE:

KEEPING OUR RAILROADS UP TO THE MARK
FIXED STARS THAT ARE NOT FIXED

SCIENTIFIC AMERICAN

A Weekly Review of Progress in
INDUSTRY · SCIENCE · INVENTION · MECHANICS

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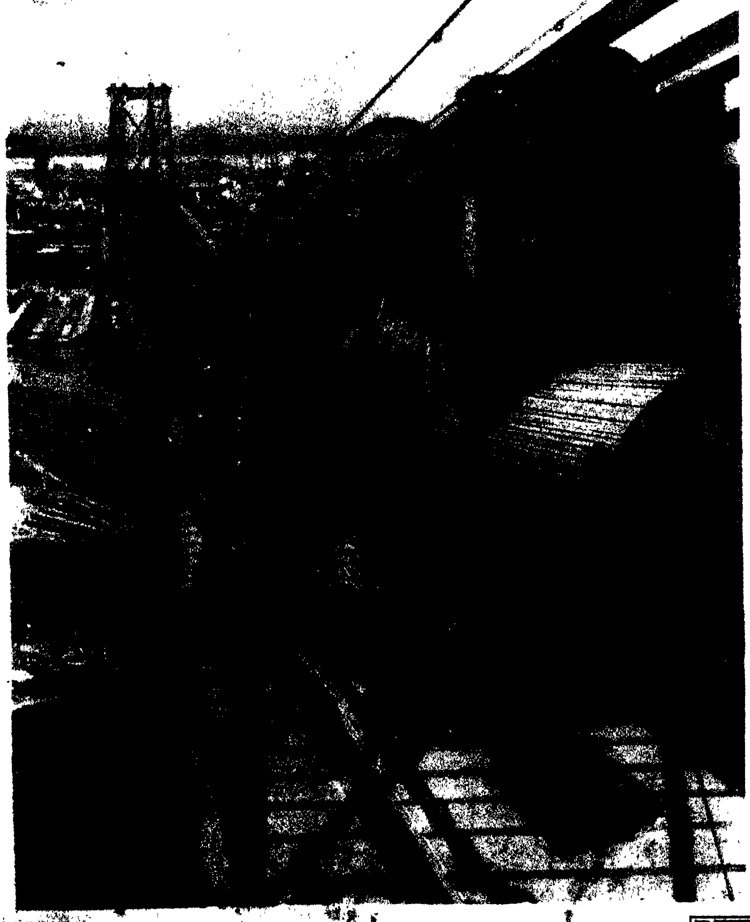

WINDING THE WIRE WRAPPING ON THE CABLES OF A SUSPENSION BRIDGE.—[See page 391]

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May 14, 1921

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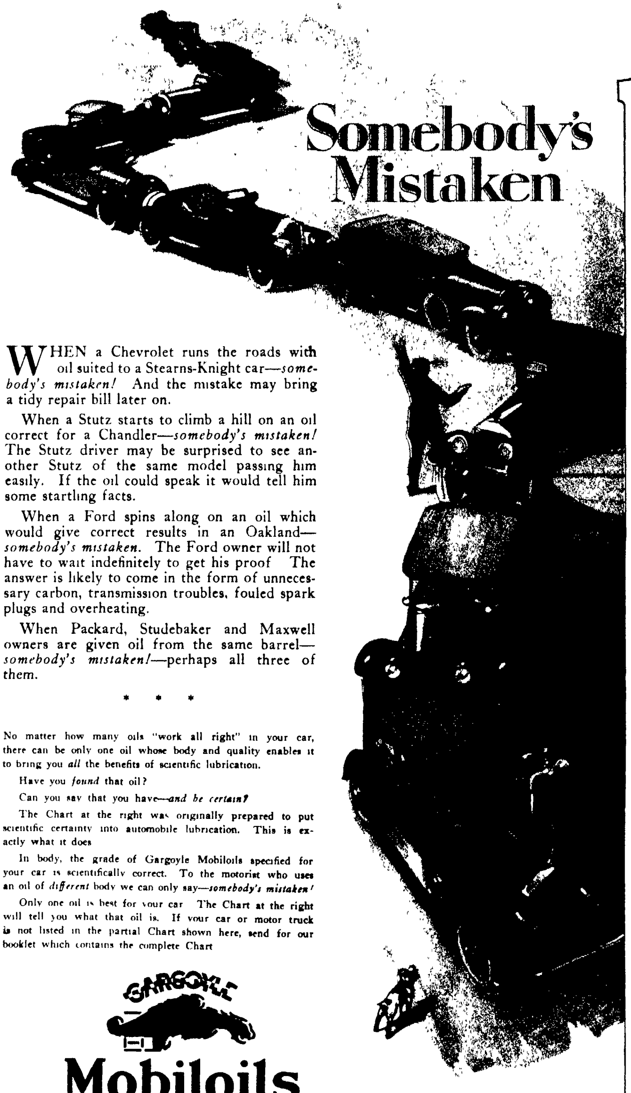
Somebody's Mistaken



WHEN a Chevrolet runs the roads with oil suited to a Stearns-Knight car—*somebody's mistaken!* And the mistake may bring a tidy repair bill later on.

When a Stutz starts to climb a hill on an oil correct for a Chandler—*somebody's mistaken!* The Stutz driver may be surprised to see another Stutz of the same model passing him easily. If the oil could speak it would tell him some startling facts.

When a Ford spins along on an oil which would give correct results in an Oakland—*somebody's mistaken.* The Ford owner will not have to wait indefinitely to get his proof The answer is likely to come in the form of unnecessary carbon, transmission troubles, fouled spark plugs and overheating.

When Packard, Studebaker and Maxwell owners are given oil from the same barrel—*somebody's mistaken!*—perhaps all three of them.

* * *

No matter how many oils "work all right" in your car, there can be only one oil whose body and quality enables it to bring you *all* the benefits of scientific lubrication.

Have you *found* that oil?

Can you say that you have—*and be certain?*

The Chart at the right was originally prepared to put scientific certainty into automobile lubrication. This is exactly what it does

In body, the grade of Gargoyle Mobiloils specified for your car is scientifically correct. To the motorist who uses an oil of *different* body we can only say—*somebody's mistaken!*

Only one oil is best for your car The Chart at the right will tell you what that oil is. If your car or motor truck is not listed in the partial Chart shown here, send for our booklet which contains the complete Chart

GARGOYLE

Mobiloils

A grade for each type of motor

Chart of Recommendations
for AUTOMOBILES
(Abbreviated Edition)

GARGOYLE

Mobiloils

A grade for each type of motor

How to Read the Chart

THE Correct Grades of Gargoyle Mobiloils for engine lubrication are specified in the Chart below.

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

These recommendations cover all models of both passenger and commercial vehicles unless otherwise specified.

Where different grades of Gargoyle Mobiloils are recommended for summer and winter use, the winter recommendation should be followed during the entire period when freezing temperatures may be experienced.

This Chart is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and constitutes a scientific guide to Correct Automobile Lubrication.

If your car is not listed in this partial chart, consult the Chart of Recommendations at your dealer's, or send for booklet, "Correct Lubrication" which lists the Correct Grades for *all* cars.

[illegible] NAMES OF AUTOMOBILES AND MOTOR TRUCKS	1920		1919		1918		1917		1916	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Acason (2 ton)			A	A	A	Arc	A	Arc	A	Arc
All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Apperson (8 cylinder)	A	A	A	A	A	A	A	A	A	A
All Other Models					A	A	Arc	Arc	Arc	Arc
Atterbury (Model 8 F)	A	A	A	A						
All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Autocar (2 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Bell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Briscoe (4 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cylinder)									A	A
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac	A	A	A	A	A	A	A	A	A	A
Chalmers (6-40)									Arc	Arc
(6-30)									A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet (8 cylinder)			A	A	A	A	A	A		
" (F A)			A	Arc	A	Arc				
(F B and 1 ton)	A	Arc								
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cleveland	A	Arc								
Columbia (Detroit)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Cunningham	A	A	A	A	A	A	A	A	A	A
Dart (1½ and 2½ ton)	A	Arc	A	Arc	A	Arc	A	Arc		
" (3 ton)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Dort	A	Arc	A	Arc						
Federal (Model S-X)					A	A	A	A		
" (Special)					Arc	Arc				
" All Other Models	Arc	Arc	Arc	Arc	A	A	Arc	Arc	Arc	Arc
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Gramm-Bernstein (5 ton)	A	A	A	Arc	A	Arc	A	Arc		
All Other Models	Arc	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Grant (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Com'l, (Model 12)			A	Arc						
" (") All Other Models	Arc	Arc	Arc	Arc						
Haynes (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(12 cylinder)	A	A	A	A	A	A	A	A	A	A
Holmes	B	A								
Hudson Super Six	A	Arc	A	Arc	A	Arc	A	Arc	A	A
" All Other Models									Arc	Arc
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jordan	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
King (8 cylinder)	A	A	A	A	A	A	A	A	A	A
Kissel Kar (Model 48)									A	A
" " (12 cylinder)					A	A	A	A		
" " All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Koehler (Model M)	A	A	A	A						
" All Other Models	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liberty	A	A	Arc	Arc	Arc	Arc	Arc	Arc		
Locomobile	A	E	A	E	A	E	E	E	E	E
Madison (6 cylinder)			A	Arc	A	Arc	A	Arc	A	Arc
(8 cylinder)							A	A	A	A
Marmon	A	A	A	A	A	A	A	A	A	A
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	A
M H M	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Mitchell (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cylinder)									A	A
Moline-Knight			B	A	B	A	A	A	A	A
Nash (Quad)	A	A	A	A	A	A				
" (Model 671)					A	A				
" All Other Models	A	Arc	A	Arc	A	Arc				
National (6 cylinder)	A	A	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (12 cylinder)			A	A	A	A	A	A	A	A
Nelson	A	A	A	A	A	A	A	A		
Oakland (8 cylinder)									A	A
" All Other Models	A	A	A	A	A	A	Arc	Arc	Arc	Arc
Oldsmobile (4 cylinder)	A	Arc	A	Arc					Arc	Arc
(6 cylinder)	A	A	A	A	A	A	Arc	Arc		
" (8 cylinder)	A	A	A	A	A	A	A	A	A	A
Overland	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard	A	A	A	A	A	A	A	A	A	A
Paige (6 cylinder)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
(Com'l. Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	A								
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Peerless (8 cylinder)	A	A	A	A	A	A	A	A	A	A
" All Other Models					Arc	Arc	Arc	Arc	Arc	Arc
Pierce Arrow	A	A	A	A	A	A	A	A	A	A
(Com'l) (5 ton)	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (") All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	A	A	Arc
R & V Knight	B	A								
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
ReVere	A	A	A	A	A	Arc				
Riker	A	E	A	E	A	E	E	E		
Rock Falls	A	Arc	A	Arc						
Saxon			E	E	E	E	E	E	E	E
Sayers Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Sayers & Scoville (S & S)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Scripps-Booth (4 cylinder)					Arc	Arc	A	Arc	A	Arc
(6 & 8 cylinder)	A	A	A	A	A	A	A	A	A	A
Selden (2½ ton)							A	Arc		
" (5 ton)	A	A	Arc	Arc	Arc	Arc				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Service (120-130-140-170-220)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Stearns-Knight	B	A	B	A	B	A	A	A	B	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Templar	A	A	A	A	A	A				
Velie (Model 34)	A	Arc								
" (6 cylinder)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Com'l) (3½ ton)			A	Arc	A	Arc				
" (") All Other Models	Arc	Arc	Arc	Arc	Arc	Arc				
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White (16 valve)			A	A	A	A	A	A		
(2 ton)			A	A	Arc	Arc				
" All Other Models			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Willys-Knight	B	A	B	A	B	A	B	A	B	A
Willys Six	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

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SEVENTY-SEVENTH YEAR

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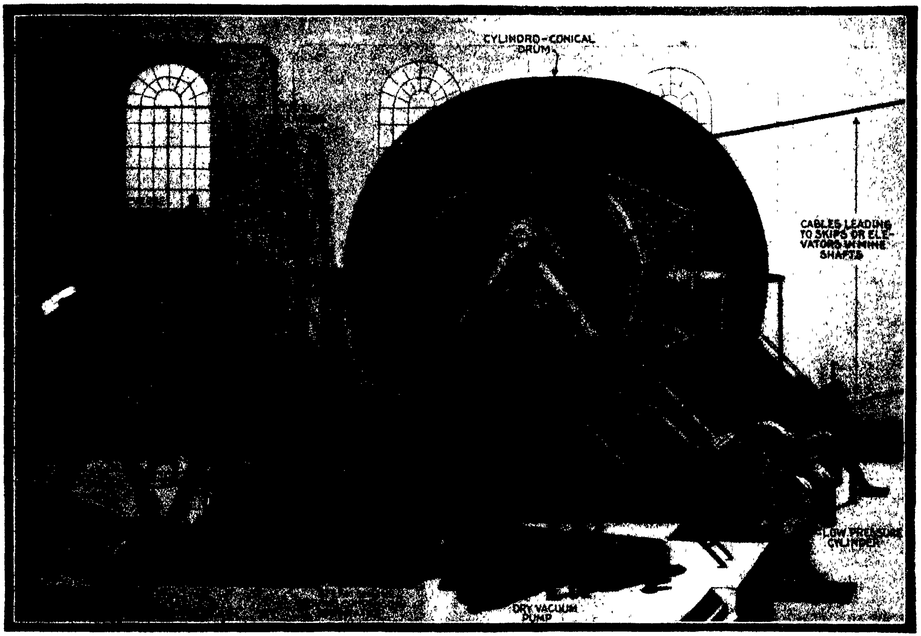

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General view of the huge mine hoist recently installed in the Lake Superior copper district, which raises a load of 20,000 pounds of rock per trip and handles 10,000 feet of rope

A Giant Among Mine Hoists

WHAT is believed to be the largest hoist in the world—and by a good margin—has recently been installed in the Lake Superior copper district This mine hoist, which has been drawn up from the constructor's blue-prints by our artist, has a winding capacity of 10,000 feet of 1⅝-inch rope reaching down an inclined shaft to a vertical depth of 6,600 feet When winding the rope down the second cone of the drum, it has a capacity of 13,300 feet, reaching to a vertical depth of 8,600 feet. The hoist operates in balance, raising a load of 20,000 pounds of rock per trip and designed for a rope speed of 3,200 feet per minute

The giant mine hoist is a cross-compound engine having two high-pressure and two low-pressure Corliss cylinders. Each cylinder is arranged on an individual frame and with its cross-head, connecting rod and piston rods, forms an engine, each engine being arranged to drive the drum shaft above it. These engines are mounted on a triangular frame at the apex of which the main drum shaft is located Each engine is set at 45 deg of the vertical and so arranged that two low-pressure cylinders are connected to one crank pin while both high-pressure cylinders are connected to the other crank pin The low pressure pistons are supported by the cross-head and tail guides The low-pressure and high pressure cylinders are provided with separate throttle valves, the high-pressure having a balanced poppet type valve, while the low pressure has a rocking valve

The drum of this huge hoist is of the cylindro conical type which is so familiar in the Lake Superior copper district There being eight impulses per revolution, together with the great mass of the drum, which weighs 516,000 pounds without the shaft all pulsation in the rope is eliminated. The drum is built up of 48 sections securely bolted together and thoroughly trussed This arrangement prevents all deflection of the drum shaft

The hoist is fully protected by an improved safety stop, whereby the throttle valve is automatically closed as the skip approaches the landing In case of over winding, the brakes are applied automatically, and the control is so arranged that the hoist cannot be started in the wrong direction by the operator Overspeed is prevented by a speed governor which controls the cut-off cams of the valve gear

At each end of the drum is a set of ingenious brakes, 16 feet in diameter, each one actuated by an oil cylinder which takes its oil from a loaded accumulator The oil cylinders are controlled by special poppet valves, one controlling the lift and the other the drop of the piston and so arranged that both valves cannot be opened at the same time The reverse mechanism and the throttle are handled in the same way

The total weight of the engine with the condensing equipment is 1,767,000 pounds The engine covers a floor space of 60 feet by 54 feet and stands 60 feet high from the bottom of the foundation to the top of the drum The foundation under the hoist and condensing equipment contains 3,000 yards of concrete

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Who Is Delaying Disarmament?

THERE can be no question whatever that the country at large was dumbfounded to learn, as it did a few months ago, that over ninety per cent of the current national expenditures are to cover the cost of wars that have occurred in the past and that may occur in the future It was this material fact as much as, and perhaps more than the moral aspects of the question that produced the practically universal demand for a reduction of naval and military estimates

In response to the taxpayers, the Government, through its various representatives from the President down, has stated during the past few weeks that we must at any cost complete the three-year program, including the six ships of the "Indiana" class although these last will cost about 250 million dollars At the same time, in answer to the widespread desire of American citizens that our President should take the lead in calling a conference to discuss disarmament, the people have been told that we cannot afford to undertake disarmament alone, and that the President must be given time for due consideration of this matter before calling such a conference Meanwhile, Congress is voting that we spend about 400 million dollars, for this year alone, upon our Navy

The astounding thing about the statement that we cannot consent to disarm until other naval powers agree to do so with us is, that the only other naval power that has hitherto surpassed us in strength not only commenced disarmament more than two years ago, but has carried the thing to such an extent that, first it is questionable whether today she equals us in the power of her first fighting line, second it is certain that if we complete our three-year program in its entirety our Navy will exceed the British Navy in capital strength by at least thirty per cent , and third · if we also round out our Navy, which will be a comparatively inexpensive thing to do, we shall exceed that Navy in actual material strength by at least fifty per cent

Startling facts, but true , for we must remember that the British first-line ships are obsolescent today, being with one exception from five to nine years old, and that by the time the seventeen capital ships which we have under construction are completed, the finest of her ships, will be from eight to twelve years old The question which we wish to ask Congress on behalf of the people of the United States who wish for economy, is Why is it that, in making these Government statements that we must go slowly in calling for a conference of disarmament, no acknowledgment whatsoever is made of the fact that the biggest navy in the world has already made this enormous stride in this very direction? Surely this is a fact pregnant with meaning, upon which the people of America have a perfect right to be informed

That we are not unduly stressing a minor point, but that we are laying our hand upon a most significant and elemental fact, is proved by the reply to a question raised in the British House of Commons on April 13th as to the number of vessels that had been removed from the naval lists of Japan, the United States and Great Britain since the armistice The Parliamentary Secretary to the Admiralty said that the phrase "removed from the naval list" had been taken to mean scrapped , and on this basis the figures are as follows Japan has scrapped two light cruisers and four destroyers , the United States has scrapped five battleships of the pre dreadnaught class, one cruiser, three light cruisers, twenty-one destroyers and fourteen submarines , and the British Empire has scrapped thirty-eight battleships of the dreadnaught and pre-dreadnaught type, two battle-cruisers, eighty-seven cruisers, three hundred destroyers, including flotilla leaders, and one hundred and six submarines.

With such evidence of good faith before us, why do we hesitate to call a conference for the mutual adjustment of naval strength and the all-round reduction of naval and military financial burdens?

The Anti-Einstein Campaign

THE intellectual world moves slowly in the matter of extending recognition to those who have consecrated their lives to the cause of reason. Mendel had been dead many years before the remarkable nature of his work was recognized When we contrast Mendel's case with that of Einstein we are forced to admit that the German physicist's sensational rise is the most extraordinary in the history of science. Barnum, king of advertisers, could not have staged a more effective or expeditious advertising campaign "

With so much of Professor Reuterdahl's article in the *Dearborn Independent* we suppose anyone will agree. But this article is given its real place by the scare head of the cover, which asks, in ¾-inch letters, "IS EINSTEIN A PLAGIARIST?" It will be at once understood that according to Professor Reuterdahl he is We expect this sort of thing from the anti-Semites of Germany, and from those of the former Kaiser's loyal supporters who resent Dr. Einstein's refusal to have anything to do with the celebrated Manifesto of the 93 Immortals. But from a reputable American source—even one celebrated for its anti-Semitism—we should look for something a little different

It is not easy for a layman to form a just estimate of Einstein's work And whatever temptation to error is presented to him will be in the direction of underestimation The phrase "relativity of motion" is not new. The Greeks had it, Newton had it, every popular explanation of Einstein starts by reminding us that this is something we have always known but chosen to ignore It is easy to overlook that Einstein has taken this familiar notion, applied it with a rigor and a consistency and a generality which it has never before enjoyed, given it a significance and got results out of it which it had never before been dreamed lay in it.

Again with the problem of gravitation. We all know that Newton solved this problem empirically only. We all know that he said nothing about the causes or the mechanism of gravitation—for the excellent reason that he could learn nothing of these We all know that since his time thousands of scientists have searched for the cause and the mechanism We do not all know what is equally true, that many of these searchers have been led to propose slight modifications in Newton's mathematical law—modifications which were in agreement with this or that observed fact

All this makes it very easy to accuse Einstein of plagiarism Not alone is everyone acquainted with classical relativity apt to judge the contents by the label on the container and assume that Einstein's relativity is the same old stuff, but the claim may with some show of plausibility be made that any investigator of gravitation has anticipated Einstein. This claim gains color in the far-from-rare case that its beneficiary can be shown to have attained results which are included in Einstein's, or to have supplied Einstein with some of his material. Nobody would claim that Einstein's entire structure is novel—the sum total of human knowledge is today too large to make it possible for a contribution like his to be made out of whole cloth.

Everyone who possesses enough mathematics to follow Einstein knows that he has made a very material original contribution—that he has formulated mathematically and as a concrete whole ideas which have had a rather nebulous existence before him, cementing the structure with ideas to which he has himself given birth His crowning achievement is the precise mathematical formulation , this has never been approached or approximated in any way.

We can paraphrase Professor Reuterdahl with some profit Never in the history of science has anyone ever made an epoch-marking advance, but what the vultures have flocked about his trail, demanding credit for what he has done and claiming ownership of the work which he has put out But never before has it been the case that the really big men of science have accepted an advance so promptly and so whole-heartedly, and left this business of picking the bones to the small fry whose names will be forgotten fifty years from now.

The Re-Birth of the Port of New York

ON Saturday, April the 30th, there was signed without ceremony or flourish of trumpets at the Chamber of Commerce, this city, a document wihch marks the rebirth of the Port of New York. It constitutes a compact by which the states of New York and New Jersey pledged themselves to close coöperation in the future planning of the Port of New York.

In the previous history of the Port its development has been retarded by the existence of a geographical boundary line, on each side of which state and municipal jealousies and suspicions have been rife, with the result that it has been impossible to secure that coöperation which wide-visioned men among us for many, many years past have recognized as being absolutely necessary to the coordinated development of the Port. The compact which has now been ratified recognises that the interests of the Port of New York, whether they lie *to the east or the west of the Hudson River,* should be considered as inseparable Henceforth the planning of the Port, in respect to its docks, piers and railroad terminal facilities, will be under the authority of a joint commission, in which both New York and New Jersey will be represented, and whose single aim will be to promote, not the special interests of any one particular section of the Port, but its interests as one great coordinated whole

Not alone will the creation of the Port Authority affect New York and New Jersey, but its influence will be felt throughout the whole of the United States, and more remotely in every corner of the world that sends or receives shipping to or from this port. In this connection, Governor Miller of New York stated that the work which this Port Authority has to do is second in importance to none "In its future consequences not only to the people within what we call the port district, but as well to the entire commerce and industry of the country, it will exceed in importance any single enterprise or undertaking that we know of." Doubtless he had in mind the high terminal charges at this port. which affect every shipper from the interior whose goods have to pass through New York. Incidentally, the fact was brought out in a homely but very telling fashion in a motion picture which was shown at the Chamber of Commerce gathering, in which the journey of a "Mr Potato" was traced from his birthplace in Michigan to the ultimate consumer in the Bronx. The cost of moving this gentleman from the breaking up point on the arrival of his train on the Jersey meadows to the market place in the Bronx was shown to be greater than the cost of the whole freight trip from Michigan to New Jersey.

Death of Dr. W. R. Brooks

WE are sorry to record the death of our old friend and contributor, Dr W. R. Brooks, Professor of Astronomy at Hobart College and the recognized discoverer of more comets (27 in all) than any living astronomer, a record only surpassed by a French astronomer, Pons, who had 28 to his credit. Dr. Brooks was born in England in 1844, made his first telescope when he was 14 years of age, and though it was a crude affair, he was able to view Donati's great comet of 1858. At 17 years of age he delivered his first astronomical lecture with charts which he made himself. As a young man he was employed in iron works in Buffalo, where he acquired mechanical skill which enabled him to make his own astronomical instruments, for it is an interesting fact that most of his discoveries were made with a telescope of his own construction. On the completion of his third instrument, in 1881, he discovered his first comet. He constructed a temporary observatory at Phelps, N. Y., where he discovered 11 comets. In 1888 he moved to Geneva, N. Y., to take charge of Smith Observatory, and it was here that he discovered 16 comets, the last one being on October 21, 1912. Perhaps Dr. Brooks's greatest achievement was in 1883, when he caught the first glimpse of the returning comet of 1812 which was discovered by Pons. Although astronomers all over the world were looking for its return they were all disappointed except the silent observer at the Red House Observatory with his home-made instrument. Dr. Brooks in his long life was the recipient of the highest astronomical honors.

Dr. Brooks wrote astronomical notes for the SCIENTIFIC AMERICAN for many years and this journal usually had the first publication of his great discoveries.

Science

"Elinvar."—This is a new alloy discovered by Guillaume, the inventor of "Invar," and is said to be an improvement over that alloy, as it is more uniformly elastic.

Books and Trees.—An average spruce tree when converted into paper yields about 500 pounds of that product. If a novel runs to 800,000 copies, the destruction of trees would be 600.

Another Medal for Mme. Curie.—The gold medal of the National Institute of Social Sciences will be given to Mme. Curie on May 19th in New York. The following day she will receive her gram of radium at the hand of President Harding. A Pittsburgh concern has received the contract for the radium. Three bids were tendered but the prices quoted are not disclosed

Paris Landlords Ban Radium Investigators.—Paris landlords who have leased apartments and offices to doctors who use radium have decided that they will no longer rent out space to them as they think that the emanations are a menace to the health of other tenants. This was all brought about by radium scientists who stated that the doctors' rooms should be lined with lead. This has naturally had its effect on timid patients and fees have dropped off

The Coliseum Loses Its Movies.—A week or so ago we chronicled the fact that the Flavian amphitheater, or Coliseum in Rome had been leased to a company of moving picture producers There was so much opposition to the scheme from all over the world that the project has been abandoned. Italy may need money, for she has always been the Cinderella of Europe, but her antiquities and works of art are her big asset and anything which tends to hurt them will hurt her financially.

Germany Increases Her Technical Journals.—There have been repeated rumors to the effect that Germany was badly in need of technical magazines. The facts are these: At the beginning of the war there were 6,250 professional journals (*Fachblatter*) published in Germany. Of these 1,900 suspended publication during the war, 90 of them permanently. But since 1919 the number has been gradually increasing. Today, says the Literary Review of the New York *Evening Post*, it totals 6,400, or 150 more than there were in 1914

Substitutes for Bone Char Discovered After Sixty Years.—A powder company has announced that a satisfactory substitute for bone char or "bone black" as it is usually called, has been discovered after sixty years' search for a substitute for this splendid decolorizing material so useful in sugar refining. The substitute is manufactured from cheap carbonaceous raw material such as lignite, which is uniformly carbonized under conditions preventing the pores of the raw material being clogged by the deposit of secondary carbon

Wireless Storm Warnings.—American mariners are to receive storm warnings by wireless from all parts of the world under arrangements perfected by the Shipping Board with most of the high-power radio stations in different countries Managing agents and masters of Shipping Board vessels were notified that the warnings would be sent broadcast on schedules furnished by the ship's radio operators. Because of the number of vessels still on the seas without radio equipment, the warnings are to be passed on from ships receiving them by other means when such vessels are sighted.

Sunday Excursions a Hundred Years Ago.—The backslider who slides into a steamboat excursion better than he slides into his pew is not necessarily of this generation. In 1821 the clergy of New York City held a meeting at the City Hall to get the sense of the community. It did not take long to find out what the people wanted and they disapproved of the interference of the clergy. The speed of the steamboats was slow, six to nine miles an hour. Those going up the Sound could not always negotiate Hell Gate and the owners provided libraries sufficient for a modern liner to while away the tedium.

Naval Vessels Prevent Pelagic Sealing.—The U. S. Government is making every effort to protect fur seals from the poachers and to prevent the invasion of the breeding islands. It is estimated that last summer the number of seal in the North under the protection of the United States exceeded one million. More than a quarter of a million of seal pups were born. The mortality among the young ones is very great, probably 50 per cent, due to the fact that the seal is the food supply to bear, eagles, the deadly thrasher and other meat-eating fish. Naval vessels and revenue cutters will protect the few seals from pelagic hunters this spring during their migration to and from their breeding ground on the Pribiloff Islands in Bering Sea.

Astronomy

A Constellation on a Flag.—From a note in *l'Astronomie* it appears that the new regency of Fiume has followed the example of Brazil in emblazoning a constellation on its flag. The constellation selected for this purpose by the Fiumians is Ursa Major.

Novæ in the Andromeda Nebula.—Three more new stars have recently been found on photographs of the great nebula of Andromeda made with the 60-inch reflector of the Mount Wilson Observatory Nova No. 18, the first nova found in this nebula in naerly two years (since October 30, 1919), is 50 sec north and 50 sec west of the nucleus, and is nearer to the nucleus than any other so far found except the great nova of 1885 Nova 18 was discovered in October, 1920, Novæ 19 and 20 in December, 1920.

The Wolf-Palisa Charts of the Heavens. — Dr. Johann Palisa, of the University Observatory in Vienna, proposes to continue the publication of the well-known Wolf-Palisa photographic charts of the heavens, if funds for the purpose can be raised by the sale of the remaining copies of the series already issued The photographs were made by Dr. Max Wolf, of Heidelberg, with the 16-inch Bruce photographic doublet. Nine series of 20 prints each have been published at Vienna. They show stars down to about the 16th magnitude. The series now on hand are offered at the pre-war price of $10 a series, or $90 for the whole collection thus far issued

Messier 72.—According to the last annual report from Mount Wilson, Dr. Shapley's investigation of the faint globular cluster Messier 72 has revealed the presence therein of many variable stars, 26 of which have been studied, giving the light-curves and periods characteristic of Cepheids of the cluster type, and indicating that the distance of this very remote cluster is 83,000 light years Assuming the validity of Eddington's hypothesis of the radiative equilibrium of a giant star, Shapley has derived theoretically a period-luminosity law for Cepheids, and concludes that the average heat content per unit mass is nearly identical for all of these stars having periods longer than three days.

Early Astronomical Instruments. — The earliest known astronomical instruments of German make have recently been described by Dr J. Hartmann, of Göttingen They belonged to the philosopher and astronomer, Cardinal Nikolaus of Cusa, who lived from 1401 to 1464, and comprised a "torquetum," for measuring the longitude and latitude of the celestial bodies, an astrolabe, and two celestial globes A note has been found in the cardinal's own handwriting, stating that he purchased three of these instruments in the year 1444, together with 16 astronomical treatises, for the sum of 38 florins. Dr Hartmann believes that at least two of the instruments were made by one Nikolaus Heybech, of Erfurt, who was born about 1370

Sensitiveness of the Retina.—A discussion has been going on lately in the *Journal* of the British Astronomical Association concerning the effects of the different degrees of sensitiveness of different parts of the retina upon visual telescopic observations Mr R L Waterfield, who started the discussion, described laboratory experiments showing that these differences are so marked as to affect, for example estimates of the brightness of variable stars made by the method of "averted vision" Thus he finds that (1) the outer side of the retina is more sensitive than the inner or nasal side for red or green light, (2) with green light the lower part is more sensitive than the upper part, but with red light, and also in the case of the average star, the contrary holds, (3) there is a great fall off in sensitiveness immediately outside the center of the retina; (4) with red light the greatest sensitiveness is found in the upper and outer quadrant of the retina, between 1 and 3 degrees from the center. Mr Waterfield's principal object was to point out how great an advantage could be obtained in the observation of very faint objects by arranging that they should fall on the most sensitive part of the retina, and that inconveniently bright objects in the same field should fall on the least sensitive part Applications of this idea would be found in the observation of comets or faint satellites close to the sun The discussion aroused by his paper has, however, centered about the question of the extent to which variable star observers use a method of averted vision in estimating magnitudes and whether their observations are seriously vitiated by this method. Mr W. H. Steavenson suggests that any errors arising from this method could be eliminated by means of a *left-to right* reversal of the field, by means of a diagonal eyepiece, the observer taking the mean of his estimates before and after reversal.

Aeronautics

The Pulitzer Race.—Elaborate preparations are being made by the Aviation Country Club at Detroit, Mich, for the Pulitzer Trophy Race which is to be held there on Labor Day The fastest machines of the Army and Navy will compete and special contests will be held in connection with this event.

Airplanes to the New Oil Fields.—Two big all-steel airplanes to be used for transporting men and supplies to the Fort Norman oil field during the coming summer have been thoroughly tested at Edmonton, Alberta, and it is found that the machines can take off quite as well on skiis as on the wheels Both machines will be fitted out with skiis, and it is expected that the new arrangement will prove of great advantage in landing on snow or ice

Making All-Metal Plane Safe.—Recent changes in the fuel feed line and carburetor air intake in the Junker monoplane are said to have eliminated the fire hazard, for which these machines have received considerable adverse criticism In the changes referred to, made by the Engineering Division at McCook Field, are included flexible gasoline line connections instead of rigid, and the carrying of the air intake outside the cowling where there is no danger of oil and gasoline around the engine being ignited by backfiring

From Airplanes to Motor Boats.—On account of handicaps connected with the Peace Treaty, several German airplane works are taking up the design of motor boats After comprehensive preparative work, one of the leading German aeronautical constructors has commenced on the construction of rowing and small-sized fishing boats This firm has also completed two motor cruisers However, in Germany as elsewhere trade is at its lowest ebb and motor boats do not find a very ready sale, hence aircraft constructors in some cases have already turned away from motor boats to total idleness

Experiments with New Aircraft Carrier. — The French Navy have been experimenting of late with their latest aircraft carrier, "Bearn," while moored in the Toulon roads The method used in landing is exactly similar to that experimented with by the British Navy, and consists of a certain number of wires stretched across the landing deck, and to which are attached sand-bags The machine, which has a special hook attached to the tail-skid, on landing picks up these wires one by one, the sand-bags acting as a brake, the load being gradually increased until the machine is brought to a stop

Still Smaller Airplanes.—The "scooter" of the air seems about to become an accomplished fact, we learn from *Flight* A young French designer, M Louis Goubert, has just completed the designs for a very small machine, which will be driven by an engine of only 10 horsepower The machine is to be a tractor, with the pilot entirely enclosed in the fuselage, which will be provided with windows The wing loading is to be 10 kilograms per square meter (about 2 pounds per square foot), and the maximum speed is estimated at 50 miles per hour, with a landing speed of about 20 miles per hour A model of the machine is, it is stated, to be tested by M Eiffel before the actual machine is built

A Giant French Machine.—From France it is reported that the Etablissement Schneider of Creusot, manufacturers of guns, armor, locomotives and other steel products, are hard at work on a new four-engined military airplane in which the four engines will be arranged in tandem inside a central fuselage The wing span will be about 100 feet, and the power plant is to consist of four engines of 400 horsepower each The machine will be designed for bombing work, and will carry several machine guns The Farman "Goliath" pilot, Lieut Gonin, has been engaged to test the first machine, while it is possible that Casale, who has already tested the Bleriot "Mammouth," will test the second machine

The Helicopter's Future.—British and French aeronautical authorities seem to be taking the latest helicopter attempts quite seriously, and look for early results in the way of practical flights In France it is expected that the crack flier, de Romanet, who is attending the experiments with the Pescara machine already described in these columns, will be a competitor for the Michelin Cup some time this year Captain Huguet, another Frenchman who has had the most intimate connection with this same machine, is of the firm opinion that the Pescara helicopter will take part in a "closed circuit" event this year It appears that the problem is no longer one of obtaining ample lift, but rather one of being able to control the thrust of the air screws, the general control when in the air, and obtaining good stability

Keeping Our Railroads Up to the Mark

Pneumatic Apparatus That Constitutes the Prime Factor in Trunk-Line Maintenance of Way

By Robert G. Skerrett

Left Air-driven corner-drill tightening up nuts on splice-bar bolts. *Center* Air-operated tool boring holes in the ties for screw spikes which likewise are driven home pneumatically. *Right* Reversible close-quarters air-drill being used to turn up bolt nuts on a splice bar

The tools of the man who keeps the tracks in shape

THE rehabilitation of our war-worn railroads is going to entail the replacement of much material. Where this concerns the maintenance of way, and especially the laying of new rails it will be essential to the national interest that the work be accomplished with the least possible interference with traffic. Economically, viewed *from the standpoint of the trunk* lines, it will be to their advantage to bring about the substitution of new rails quickly and by the employment of a minimum of labor. Mechanical facilities are today at hand that lend themselves readily to these ends.

The locomotive crane is not an unfamiliar apparatus to many people, and this equipment has proved well adapted to the rapid laying of rails even when these track members are of the heaviest types. Where the big and busy roads use rails ranging from 100 to 136 pounds to the yard it is easy to grasp the physical stress involved in the manual shifting and placing of these units, and there are seasons of the year when a large working force must be mustered to deal with a relaying job—this is particularly so during the summer months when such toil is apt to be very exhausting. Therefore, the locomotive crane is being more and more resorted to by progressive lines to speed up rail replacements while reducing greatly the measure of man power necessary.

But until recently the fullest service of the locomotive crane has not been permissible, simply because it could perform its part a good deal faster than the relaid rails could be properly bonded. By bonding is meant the boring of certain holes, the attachment of short lengths of wire through these holes, and the making of other electrical connections. Bonding is indispensable to the preservation of the metallic continuity of the track circuit by which the automatic signal system is functioned. Without these links the electric current would fail to flow and to operate the semaphores and the changing lights. In short, it would be dangerous, if not prohibitive, to run trains over tracks defective in this respect.

Drilling bond holes has commonly been a wearisome and a monotonous task, and long before a day's shift was done the men lost interest and dawdled over their work. Not only that, but a good many hands were needed to effect the desired execution. On one up-to-date eastern road, where the main line is laid with 136-pound rails, the locomotive crane has associated with it, in its relaying activities, an equipment that has robbed bonding of its drudgery and which has made it feasible to do this work at a rate of quite 100 rails an hour. As an example, fully 350 lengths of these heavy rails were unloaded and laid in a total elapsed span of six hours—the old rails being picked up and disposed of the while. Within an interval of sixteen minutes after the rails were in place and connected the bonding was completed.

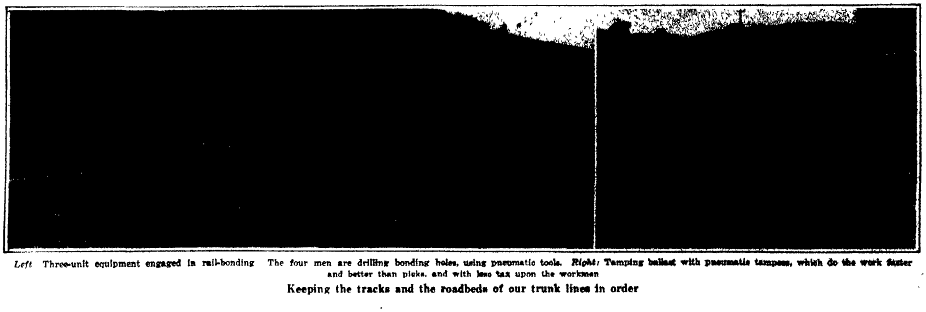
To realize the time and labor saving represented by this typical performance, it should be recalled that the number of men required is not half the force that would be needed by the old and widely prevailing practice. The achievement has been wrought by amplifying the field of application of the mobile power plant designed primarily for the operation of pneumatic tie tampers. That is to say, substituting a group of air-driven drills in place of the usual hand tool. By these media the drilling gang can do more with less muscular tax in a given time; and because the work can be pushed ahead at a lively pace their interest in their task is not only stimulated but is sustained.

The extemporized outfit has taken two forms—consisting of a single unit in one case and of a triple unit in the other. The single unit is a small push car carrying a gasoline-driven compressor. Secured to one side of the housing is hung, parallel with the track and at a height of about 6 feet, a 21-foot length of 1¼-inch pipe with brackets at each end. These serve the double purpose of supporting the air hose and as resting places for the drills when not in use or during a shift from point to point. By means of a number of two-way connections it is possible to attach four lengths of hose to the primary source of energizing air, and this enables four men to drill simultaneously. The one shortcoming of this outfit is that the power plant must be shoved from place to place, and the work becomes rather taxing when it is necessary to negotiate a climb.

The three-unit installation is composed of a similar compressor and truck linked between two motor cars which speed up progress, make it practicable to mount any gradient at a good pace, and provide for the transport of the gang and for the accommodation of the tools, extra apparatus, bonding wire, etc. The little train is joined by two sections of 2-inch pipe, each 20 feet long, which are flattened at the ends and pierced with holes into which bolts or pins can be set to lock the cars together. The air is distributed from the compressor by an overhead pipe ¾ of an inch in diameter, having a reach of substantially 80 feet. This conduit is supported at several points by stanchions rising from the motor cars and from the car-linking pipes. The air main has a hose connection at either end and at two intermediate points. These taps feed four drilling machines, and air is supplied at a pressure of 80 pounds for that service. By reason of this arrangement short lengths of hose answer for the tools and to give the operatives free play.

As soon as holes have been bored at four joints, the drills are hung on hooks provided for that purpose on the motor cars, the men jump aboard, and the train advances to the next job. The shift to the succeeding "set-up," a rail length away, is effected in less than half a minute. With the hand-pushed outfit a crew

(*Continued on page 395*)

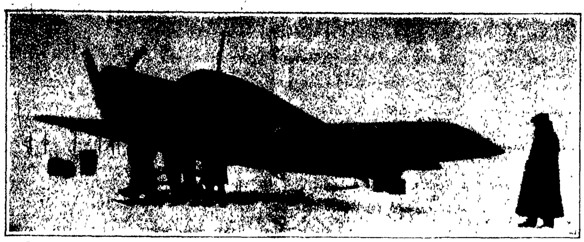


Left Three-unit equipment engaged in rail-bonding. The four men are drilling bonding holes, using pneumatic tools. *Right:* Tamping ballast with pneumatic tampers, which do the work faster and better than picks, and with less tax upon the workmen

Keeping the tracks and the roadbeds of our trunk lines in order

Canada's Big Oil Strike

By Thomas M. Fraser



Communication between headquarters at Edmonton and the Canadian oil fields, nearly 1,000 miles distant, will be maintained by all-metal planes of this type

JUST 25 years ago the whole world was aroused by the story of the discovery of fabulous wealth in the Klondike, and for some years thereafter the almost inaccessible river beds and benches of the Yukon were the lodestones which drew adventurous gold seekers from all parts of the earth. Many great fortunes were made in what the Indians called the land of "too much gold"; many, too, were lost, and many lives along with them in the gamble with the relentless north. Now once more from the barren places of Canada comes the call to the prospector to try another throw with Fortune This time it is oil, and judging from the preparations being made to be in on the game when the ice breaks on the great lakes and rivers in the Mackenzie district in the late spring, the Yukon will have little or nothing on the Mackenzie The rush to the oil fields on the Mackenzie River will be one of the landmarks in Canadian mining history, and the Mackenzie will probably do for Edmonton what Dawson and the Yukon did for Seattle

Toward the close of navigation last fall word filtered out by moccasin telegraph that a big oil strike had been made on the Mackenzie River. Later, accurate information was received by the Dominion Government that what looked like an important discovery had been made at a depth of 800 feet after prospecting and drilling operations extending over a year This first gusher was struck at Fort Norman, which lies about 900 miles in an air-line northwest of Edmonton, on the right bank of the Mackenzie River The distance from Edmonton by the ordinary routes of travel is about 1,750 miles.

The report of the oil company was sufficiently conservative; "Well is very encouraging, and while somewhat over-rated by the press, warrants the hope that prospecting of the area will result in sufficient production being obtained in a few years to warrant the development of some transportation scheme whereby the production can be utilized" Unofficial reports were to the effect that the flow would amount to from one to two thousand barrels per day. It was enough. If the clammy hand of winter had not closed down upon the territory, the rush would before now have been in full swing.

Toward the end of January, 1921, the Government suddenly announced that all oil and gas regulations in the Northwest Territories were suspended, and threw consternation in the hordes of prospectors who were outfitting in the north or actually in the field. The official announcement made when the regulations were suspended noted that the reported discovery of an immense oil-bearing territory in the Mackenzie River district, estimated to cover an area of 150,000 square miles, had for some time been receiving the attention of the Government "There is reason to believe," it added, "that oil has been found in large quantities, and indications are that this district may soon become one of the greatest oil-producing areas in the world The importance of such a discovery to this country cannot be overestimated, and the Government is watching the situation very closely On the recommendation of the Minister of the Interior an order-in council has been passed suspending all previous petroleum and natural gas regulations insofar as they apply to the Northwest Territories, the reason given for this action being that the Government considers the recent discovery of national significance and that the conditions are now the subject of careful inquiry"

Although there were numerous complaints regarding the Government's action, it was dictated by a desire not to be caught napping as they were to a great extent at the time of the Yukon discoveries So far as the Government is concerned, it proposes to do everything in its power to see that wild-catting and exploitation of the public be made as difficult as possible that legitimate prospecting be encouraged and that the state duly benefit from any discoveries made The new regulations are devised with this end in view

The history of the new Oildorado, as some wag has

(Continued on page 395)

Fort Norman, the town that has sprung up in the center of the new oil fields of the Canadian Northwest

Motorizing the Rural Church

By O. R. Geyer

THE old fashioned rural church which dotted many thousands of hillsides a generation ago is rapidly disappearing these days in answer to the demand for greater efficiency and service in the work of the church Hundreds of these small churches are no longer in existence and hundreds of others are doomed to disappear before the flood tide of the rapidly changing times has been reached A responsible factor in bringing about this drastic change in the religious life of the rural community has been the automobile and its twin companion, good roads

Rural life experts and leading church workers freely admit the part played by the motor car in bringing about this great change The decline of the old-fashioned church first engaged public attention at about the time the automobile was gaining a foothold in the country districts, and from that day to this has continued with ever increasing force Perhaps the chief reason for this has been the important part played by the automobile in annihilating distances and in bringing about a larger and better community spirit Where three and four churches were deemed necessary a generation or so ago, because of poor roads and thinly settled districts, one church today is doing the work of its predecessors with much greater success

The falling off in the number of rural churches had reached what might have been an alarming rate but for other compensating factors in the days before the opening of the World War Instead of halting this decline, the war served to make certain its continuation along more drastic and effective lines as it contributed to the quickening of the religious life of the country The spiritual and economic influences brought to bear by the war have served to hasten the departure of the old order and the introduction of the new Waste and inefficiency in worship are to be tolerated no longer, and the weak and ineffective churches which dotted so many rural hillsides are giving way to community churches which are bringing to bear a much stronger influence upon the religious life of the neighborhood

Officials of the Methodist church, in a recent report, cite the automobile as an important factor in bringing about this important change in the religious life of the farming country There is no bemoaning of the change for church leaders as a rule are strongly convinced that the change is for the better They are giving full assistance to the work started through the agency of the motor car and good roads, because they realize the necessity of the new rural church An illustration of the good that is being ac-

(Continued on page 395)

Left: Two country churches, side by side, typical of the conditions of ten years ago Center A demonstration of the vogue of the motor among the church-goers of the countryside Right: New type of rural worshipping place made possible through the popularity of the motor car, its congregation drawn from a wider territory, and more interested in appearances

The transformation of the country church effected by the popularization of the automobile

Fuel Conservation Opinions—II

What Leading Consumers of Fuel Have to Say About the Present and the Future

As Reported by Austin C. Lescarboura

IF, as was discovered upon reading in our last issue the first instalment of this article, which is herewith concluded, there are so many and varied opinions regarding the most satisfactory fuels now in use, the same may be said for the new fuels and sources of power for the future. It is quite to be expected that each fuel consumer has his own opinion as to what will constitute the fuel and the power of tomorrow, since he looks at the problem through his particular spectacles, so to speak. He sees the problem in the light of his present requirements and past experiences, and proceeds to offer a solution accordingly. All of which is what makes such an interchange of opinions all the more interesting, presenting, as it does, so many different yet worthy viewpoints —THE EDITOR.

EVERYONE connected with the work of developing water power seems to be quite positively of the opinion that the next few years will see a development of the hydraulic resources of the United States on a much more extensive scale than has existed in the past There are several contributory reasons for such a vast development, we are told by **Mr. A K Birch** of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., which might be enumerated as follows·

1st. The high coal prices permit of utilizing water powers which have heretofore been left idle on account of high development charges

2nd Public sentiment seems to have become sufficiently educated to distinguish between conservation of exhaustible resources and an inexhaustible one

3rd Government approval of further water power development has been granted in connection with the passing of the new power bill

4th Not only have the limits of cost development been raised by reason of higher coal prices, but there is a considerable group of owners who are going ahead primarily on the assumption that they can secure greater returns from water power development by reason of absolute freedom from labor conditions in the coal field, transportation difficulties in emergencies, and the labor shortage, so far as their own coal-burning plants are concerned

Saving Man-Power with Hydro-Electric Units

In the American Society of Mechanical Engineer's *Journal* of September, 1920, Mr White, of the aforementioned company, makes a very significant presentation of the labor question in the following words

"There has been installed recently at Niagara Falls a combined hydroelectric unit of 40,000-horsepower capacity. The operation of this unit requires two men per shift It has been calculated that to produce the same amount of power by small isolated steam plants, as would be the case were the water power not developed, there would be required over 800 men to mine, hoist, break, screen, load, transport by railroad, unload, store, rehandle, and fire under boilers the coal necessary to develop by steam an equal amount of power The operation of this one unit conserves not only one train load of coal per day, but also conserves the man power which would be required to produce it This striking example shows the great amount of man power which can be conserved for other fields of endeavor by developing our water powers

"May it not be that the shortage of labor to accomplish the tasks before us today has been brought about by the failure to follow that path in the development of our natural resources which leads to the minimum of human toil?"

Frankly, the case for the hydroelectric plant is admirably and convincingly put by Mr White, although it will be noted that the labor shortage which he referred to in September, 1920, has to some extent disappeared in the short intervening period

How Fuels Are Made to Do More Work

Six months ago it was the high prices and scarcity of fuel that caused many large consumers to seek fuel conservation, today it is the necessity of reducing costs in order to meet the buyer's modest and cautious bid that is again causing or is about to cause energetic fuel conservation in many quarters At any rate, many interesting and novel economies are being effected, which tend not only to save fuel on the one hand, but, to put it another way, make each pound of fuel do more work

One large consumer of fuel reports that in its power house the conservation methods have consisted of a development to utilize exhaust steam for heating purposes during the cold season, in addition to improvements in condensing apparatus and arrangements which improve the efficiency of the power house when it operates without the heating load, as well as during the cold weather As builders of steam prime movers this consumer in question has given attention to the subject of reheating of steam. However, this idea has not been applied recently to any of its apparatus, although it did make use of such a plan several years ago in water works pumping engines. This company believes that such measures as reheating of steam will be warranted, provided the cost of fuel remains high.

It appears on careful survey that railroads of late are giving no little attention to fuel conservation. Thus **Mr. A. T Hardin**, Vice-President of the New York Central Lines, informs us that his organization has a completely equipped fuel conservation department, which includes a fuel instruction car that is sent over the road with a staff of experts to assist in instructing engine crews as to proper firing methods, etc. This department also looks after the stationary boiler plants, where a campaign has been conducted with the view of obtaining economy in coal consumption, including proper heat insulation. The locomotives are all equipped with the latest approved devices for the economical use of fuel.

In the same vein runs the statement of **Mr. W. L. Bean**, mechanical assistant to the President of the New York, New Haven & Hartford He tells us that his railroad has equipped its locomotives to a varying extent with such fuel-saving devices as firebox arches, superheaters, feed-water heaters, and stokers. Furthermore, a staff of fuel supervisors covers the system in order to instruct and demonstrate to the employees the proper methods of firing. Economies are also effected in stationary plants, with some additional refinements that are not possible in the usual steam locomotive

Still another railroad the Illinois Central, speaking through its vice-president states that for a number of years it has practiced fuel conservation through educational methods, inspection of coal at the mines, and application of proven devices, such as super-heating, brick arches, etc. During the past eight years through systematic effort in this direction, the railroad has effected a reduction of over 84 per cent per 1,000 gross ton miles

It appears that all railroads of the first order have for some time back paid considerable attention to fuel conservation, both by means of instruction to locomotive crews and by the installation of worth while devices This fact is perhaps unbelievable to the average layman, whose rapid trips through railroad terminals with their vast stores of coal lying all about with seeming indifference, has naturally led him to believe that such a common commodity was being handled in an unsystematic and reckless manner

Keeping Watch for Fuel Thieves

There are few large plants today which are not exerting every reasonable effort to use less fuel for more work. Such plants have in many instances equipped their boilers with modern mechanical stokers, and have carefully insulated their boilers and steam pipes so as to reduce losses through radiation to a minimum. Also, boiler settings are kept tight In instances where it is estimated that considerable economies can be effected, steam units are changed around or even discarded for better equipment in order to effect real fuel conservation.

Most interesting of all, no doubt, is the careful watch maintained day after day for fuel thieves—those avoidable losses which subtly run up power producing costs Thus many of the large fuel consumers watch their flue gas analyses for excess air, keep an accurate tabulation of firing conditions, and compare the results from day to day with past performance. Truly, we Americans are no longer the wasteful people which we have been pictured to be in the past by our European friends!

Any discussion of fuel conservation on a nation-wide scale brings up for discussion the super-power zone problem, which has been dealt with from time to time in these columns. In a word, the super-power zone means the grouping of all the large power producing units in a given area into one huge system, pooling the supplies and the production, and with transmission lines carrying the electric current generated in all directions. The super-power zone, operating on a vast scale, insures the economical production and distribution of power in a manner that is quite impossible with our present system of scattered and isolated plants.

Grouping Power Plants Into Super-Power Zones

That the idea of super-power zones is not altogether an untried one may be gathered from the facts regarding the Ontario Power Commission's work, which recently appeared in these columns. Furthermore, we are now informed by **Mr. R. H. Ballard**, Vice-President and General Manager of the Southern California Edison Company, that the power systems of California have been operating for the past several years to some extent on an interconnected basis, making power interchange between the separate systems whenever economies could be effected. At the present time the systems of California, extending the entire length of the State from San Diego to the Oregon border, a distance of about 700 miles, may be interconnected, although in some places by low capacity connections. The near future will see this entire territory supplied by a super-power bus operating at 220,000 volts and supplying the local distributing systems along its route.

The advantages resulting from the diversity of loads in contiguous territories supplied by separate systems, and the economies of development on a large scale of big units, will bring about a more extensive interconnection or consolidation, concludes this authority.

Of course, the super-power zone idea works out best where we are dealing with a densely populated section of the country. In connection with this idea, one authority suggests that the location and size of the power plants and the prime movers installed in them, should be such that it will be possible to take full advantage of the use of exhaust steam for heating and industrial purposes. Still another authority states that the grouping of power plants will, of course, enable the plants so grouped to obtain a more economical load factor and will also make possible the use of large stoker, boiler and turbine units, with attendant savings through the inherently better efficiency of the larger units.

Returning again to the subject of district heating, we are told that the "grouping" of power plants would appear to overlook the great importance of district heating in the various cities. When the best economies are worked out, indicating the advisability of the larger installation, consideration should be given to the "stand-by" plant, which will insure uninterrupted electric service and secondly, make possible the continuation of the present heating system or the taking care of heating requirements, from the present centrally located power plant. A great many competitive situations are created when and if the power plant, with the single idea in mind of grouping, neglects the present or prospective demand of central heating in the cities. This plea of giving due consideration to the central heating problem is worth listening to; for there is only a limited gain should economy be effected in the generation of electric current, while more fuel must be used for the heating of cities. The suggestion has been advanced by several authorities that in the super-zone scheme the present steam plants should be used as "stand-by" plants, ready to generate electricity in an emergency, while in normal periods furnishing steam heat to city offices and dwellings.

As with most other projects, there is another side to the super-power zone. Admitting that the shutting down of small plants can be accomplished with a saving of much fuel, many hold that the time is not ripe for such a grouping of power units.

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Farming with Electricity

A Hundred-Thousand Acre Tract That Is Fully Equipped with Modern Machinery

By Ralph Howard

HOW the barrenness of the desert has responded to the reclaiming touch of man is an oft-repeated story of the West, the Government project embracing 121,310 acres in Cassia and Minidoka Counties, Idaho, being a notable illustration. The astonishingly swift transformation of this once vast area of desolation into a fertile farming region—all within 13 years—is an inspiring achievement of itself, but of more singular distinction is the conspicuous rôle that electricity is playing in the farm homes of this big agricultural community. With 1,100 farmers applying electric current in producing and harvesting their crops, doing the chores of the housewife, and illuminating and heating the homes, schoolhouses and churches, no other rural section in the United States has accorded such all-embracing favor to this form of power as has this hydroelectric project in south central Idaho

Electricity as a servant of city dwellers is of increasing popularity, but its common adaptation to rural life is a dream of future accomplishment Its use in agricultural areas is a novelty, restricted to isolated examples in progressive communities. Herein the Minidoka enterprise, administered by the Reclamation Service of the United States Department of Interior, takes a radical departure. Electric current becomes an agent of almost universal recognition in an expansive rural area, where the most populous town, Burley, claims only 4,000 inhabitants. Rupert, a village of ranking importance, has barely 2,500 souls; the two mentioned burgs being products of the reclaiming powers which extended its magic wand over 121,310 acres and transformed the desert into agricultural units yielding a wealth of alfalfa, potatoes, sugar beets, small grains, as well as nurturing a beef and dairy cattle industry. No manufacturing industries of consequence are fostered; two beet-sugar factories, a potato dehydrating plant, two cheese factories, and several alfalfa mills, constituting the magnitude of manufacturing All of which brings into relief the aspects of a slogan of the city, "Do it electrically'—applied on the farm

The engineering equipment includes a diversion, power and storage dam on Snake River, 7 miles south of Minidoka, two canal systems, one on each side of the river at the diversion dam, and three main pumping stations. There are 634 miles of canals, and the gravity system embraces 72,348 acres The power plant is a creature of necessity in pumping water to approximately 50,000 acres during the irrigation season, thereby, the electric current distributed to country dwellers is a by-product Of the 3,000 consumers of electricity, 1,100 are honest-to-goodness farmers Substations have been built and distributing stations have constructed 290 miles of 2,200-volt circuits, extending 250 miles through rural communities Although avoiding extensive retailing of electric power, the Reclamation Service takes the initiative in the organization of companies composed of farmers, which are incorporated and operate as mutual enterprises under the statutes of Idaho These operating units build their own 2,200-volt lines, install transformers, and dispense current to individual consumers The Federal Government acts as a wholesale distributor of power which is obtainable at substations conveniently located on the 30,000-volt transmission system

The energy as supplied wholesale by the Department of Interior to farmer companies is based on a charge of $2 a month per kilowatt of maximum demand for the equivalent of the first 50 hours' use of the maximum demand for the month, 3 cents a kilowatt-hour for the next 50 hours' use of the maximum consumption, 2 cents per kilowatt-hour for the succeeding 50 hours consumption of the ultimate needs, 1 cent a kilowatt-hour for the next 150 hours' use of the maximum requirements; and ½ cent a kilowatt hour for all energy used in excess of 300 hours' use of the supreme needs The rate also recognizes a block discount based on the contractor's guaranteed maximum demand, increasing from 2 per cent for 2-kilowatt contracts up to 30 per cent for a contract of 100 kilowatts or more Likewise a discount of 10 per cent is granted wherever energy is delivered and measured at 2,200 volts A rural distribution line, including accessories, can be built at an expenditure ranging from $500 to $1,000 a mile, ordinarily four farms being linked for each mile connected to the circuits The farming unit is 80 acres Twenty farm companies have been organized, supplying approximately three fourths of the rural consumers Other users receive their electric current from lines vitalized by the systems of the various towns, barring 40 farmers who obtain a supply direct from the Government on individual contracts

Interesting observations have been assembled as the results of study of the distribution of electricity on this Government project, which is the premier rural consumer in the United States The use of a diversity of electrical appliances improves the load factor, and the energizing current of the rural dwellers' transformers floating on line likewise enhances the load factor The load tests indicate that the companies' peak burden is always at the time of the lighting peak. The individual farmer consumer has a day peak, which averages three times his average night peak The diversity of the day burdens, however, is such that the excessive individual needs do not affect the companies' maximum demand The companies' evening peak is three to five times greater than the day load The power factor of a rural company rarely exceeds 50 per cent except during the evening lighting peak Distribution losses in kilowatt hours range from 30 to 50 per cent, primarily attributable to the energizing current of the transformers One half of the rural distribution systems employ iron wires for conductors. The largest company on the project serves 165 farmers on 38.5 miles of line, comprising 13 miles of 3-phase No 6 copper wire, 3 miles of 3-phase No 8 iron wire, 3 miles of single-phase copper, and the remainder single-

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Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

The Einstein Contest

To the Editor of the SCIENTIFIC AMERICAN

It is a real pleasure to read the prize essay on the Einstein theory and note the absence of weird mathematical symbols. One who has completed the ordinary college mathematical courses including calculus, feels that he has a real grievance when he encounters strange mathematical symbols, with no hint as to what they mean or how their meaning can be found at the library He may also have a sneaking suspicion that the thirteen super-minds might be slipping something over. Having hastily suppressed that thought, perhaps he recalls instances where he himself has used mathematics to solve a problem and found that there was more than one answer. Perhaps one of the answers involved $\sqrt{-1}$ known as an "imaginary" answer, or for some other reason the conclusions drawn from it would be even stranger than those of the Einstein theory. All of which confirms the proverb that mathematics is a good servant but a bad master.

The statement that a yard-stick changes its length when turned around 90°, and that a watch runs at a different rate when on a fast train, will not be accepted by the skeptics on the mere statement that it is so, nor on proof so entirely mathematical as to be beyond control. Of course the essayist could not be expected to prove anything. He was only expected to explain, and this he has done so well that he, Mr. Higgins and the SCIENTIFIC AMERICAN deserve the greatest credit.

The weak point is the failure to state definitely the fundamental assumption on which the entire theory is founded, viz.: that the absolute velocity of light (in a vacuum) is constant. In other words that all space is filled with a fixed ether that does not partake of the motion of the earth. This ether was invented long ago to explain the transmission of light. A very attenuated kind of super-gas will not answer the requirements It must be a solid body, vastly more rigid than the strongest steel, and yet allow the earth to pass right through it without offering the slightest resistance and without being displaced the slightest amount by the earth In accepting such an ether, one is simply forced to make some mental reservations Perhaps it should be taken in the sense of the familiar comparison between electricity and a circulating system of water pipes It can't be taken too literally

While such a fixed ether explains nearly all the facts about light, it does not explain quite all It is directly contradicted by the measurément of the aberration of light, with a telescope filled with water The ether theory is not so well established but that it is still subject to minor modifications. The ether, for example, may not be fixed; some of it may be carried around with the earth, and there have been other suggested modifications of the ether that would entirely upset the Einstein theory

With a fixed ether, of course the earth would sweep through it at some 18 miles a second, in its orbit around the sun. At midnight the ether would seem to us to be coming from the east Its direction would change as the earth rotatés on its axis, so that by morning it would seem to be coming down on our heads

This is the way the ether was supposed to be sweeping through the laboratory while Michelson and Morley measured the velocity of light Yet it was found that the apparent velocity of light was the same at all hours and that is right where the trouble started that is threatening to drive us crazy

To the normal mind this experiment simply showed that the ether was not rushing through the laboratory at 18 miles a second. Einstein's deductions are all the proof that is necessary that the laboratory was not moving through the ether at all But the German mind when confronted with the discrepancy between the theoretical result and the experimental result, instead of seeing that one or the other result must be wrong saw that both results were right and all the rest of the world wrong So the discordant results were equated to each other, the equation was solved, the interpretation of the solution was proclaimed, and the world was plunged into mental anarchy

But let us make another experiment This one won't cost anything because the skeptics will agree with the super-minds as to the outcome and will disagree only on the explanation. Let us take two clocks: one with a balance wheel escapement, the other with a pendulum escapement The axis of the balance wheel will be placed parallel to the axis of the earth We will neglect the velocity of about a quarter of a mile a second due to the rotation of the earth on its axis and assume that the motion of the axis of the balance wheel through space is uniform The time rate of this clock will therefore be uniform The pendulum of the other clock will beat at the normal rate at noon and midnight when its motion through space is transverse But in the morning and evening its motion through space will be endwise, and Einstein tells us that its length will shorten Therefore it ought to beat faster If the earth's radius also shortens, gravity ought to get stronger and cause the pendulum to beat still faster. Every one will agree that the two clocks will actually keep together To the skeptics there is nothing about this to explain It is up to the super-minds to show some effect that would exactly compensate for the supposed change in length, presumably by amending the law of gravitation It would be very interesting to know how this can be done without annulling their proof of the motion of the planet Mercury. But we will never know, because if they should answer this question it would be with another flock of weird symbols of unknown meaning GILBERT S WALKER

New York

The Knife and Fork in One

To the Editor of the SCIENTIFIC AMERICAN

In a recent issue I saw a description of a "new" combined knife and fork for the use of maimed soldiers I think, but am not sure, that the implement in question was sold by Gamage of London Eng long before the Great War

It is a very old tool by the courtesy of Messrs Read of Dublin, I was allowed to make a tracing of their model, the age of which is uncertain, but well over 120 years This firm sells occasionally to special customers razors, knives (all descriptions) and scissors guaranteed over 100 years old The steel is known to them as 'silver steel' is of magnificent quality, polishes the color of silver, and retains the edge for years without regrinding, or in the case of razors, resetting The business was started 273 years ago and has continued without a break (REV.) R W TALBOT

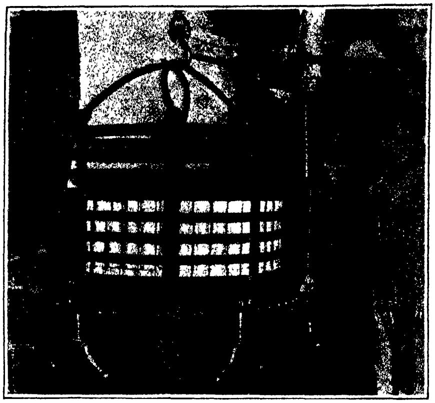
Loughrea, Ireland

When Oysters Are in Season

How the Raw and the Canned Products Are Prepared for the Markets

By S. R. Winters

"OYSTERS a Specialty in Season," is a familiar inscription in the city, with slight variance of the text, oyster dealers, grocerymen, restaurant and hotel proprietors contributing to the frequency of its appearance As stimulating as the imagery may be to the appetite, suggesting an inviting dish of raw, fried or one of the sundry ways of serving this relished water product, the consumer hardly realizes the vastness of the oyster industry Well may one marvel, then, when informed that the highway bearing the speeding automobile is likely built of oyster shells, the railway express may be steadied by a ballast of fish shells, that grit may be supplied to the craws of backyard poultry, and excessive acid soils of farming land may be relieved by lime produced in a kiln of burning oyster shells



Basket of canned oysters being lowered into the steaming kettle

Oyster culture represents the most valuable fishery in the United States The 1920 yield approximated 30,000,000 bushels, having a valuation of $15,000,000 to fishermen The latest inventory as to the magnitude of the industry in personnel and equipment employed for twelve months indicated that 67,257 persons were thus engaged, drawing wages aggregating $10,876 801, using vessels and apparatus appraised at $17,000,000 Ninety nine per cent of the oysters are taken from the Atlantic and Gulf coasts, Maryland, Virginia and Connecticut, in the order named, having foremost ranking in yields Chesapeake Bay this story threading itself around its fishing activities primarily, gives up more oysters than any other body of water in the world Virginia and Maryland, through which this huge pond navigates, produces 5,000,000 bushels of oysters each annually Connecticut is credited with an output of 4,000,000 bushels

Hand tongs, patent devices, dredges lifted by hand or hand windlasses, or dredges raised by engines or hoisters turned by the engine of the boat, are the implements used in lifting the oysters from their watery beds Hand tongs have common usage, the device comprising two long, flat, smooth wooden handles three inches wide and one inch thick bolted, riveted or pinned together with a wooden pin, scissor-like fashion, about four and one half feet from one end, leaving the long ends for handles To the short end of each shaft is secured at right angles a light iron bar, three and one-half feet long, spiked with teeth, while above the bar are five or six even lighter bars or heavy wires parallel to the bar and attached to the shaft The ends of the bars are secured together by abbreviated wires. The arrangement on each shaft permits the teeth to slope inward, thereby forming a basket-like contraption when the handles are closed. Its dimensions are three and one-half feet long and eight or ten inches deep. In action, the handles are negotiated as one would a pair of scissors, and the teeth forced under the oysters retained in the basket, which is then lifted. The depth of the water being explored determines the length of the oyster tongs. In one instance the apparatus is inserted to a depth of 20 feet.

A hand dredge consists of two triangles constructed of three-fourths inch iron bar, joined at the apices, and the bases separated 18 inches by curved bars. Its width is four or five feet The base of the lower triangle being composed of a bar one and one-half inches thick, to which teeth three inches long, set three inches apart, are placed. A rope or wire cable inserted in a ring at the apex of the dredge permits the lowering and raising of the fishing tackle, hands or hand windlass being employed. Maryland sanctions the use of a heavier dredge, which is operated by a donkey engine having quarters on the deck of a sailing vessel Legislation prohibiting the use of other motive power than sails in dredging, the engine simply operates the dredge The vessel is propelled exclusively by sails As depicted in the illustration, the oysters are shoveled from the deck into buckets and hoisted to the wharf by a rope over a pulley and operated by a crane with a donkey engine as a source of power. The buckets having been emptied on to the wharf, the contents are subsequently removed in wheelbarrows into a room level with the wharf where the oysters are deprived of their shells Quite logically, the process is called shucking.

Oysters are marketed in three conditions—in the shell, shucked on ice, and canned The first two named forms have given birth to the so-called raw-oyster house, while the latter state of preparation involves the establishment of a cannery The products are shipped in the shell in barrels, although for short hauls they may be consigned in sacks without ice Refrigerator cars are employed for long-distance journeys Export trade

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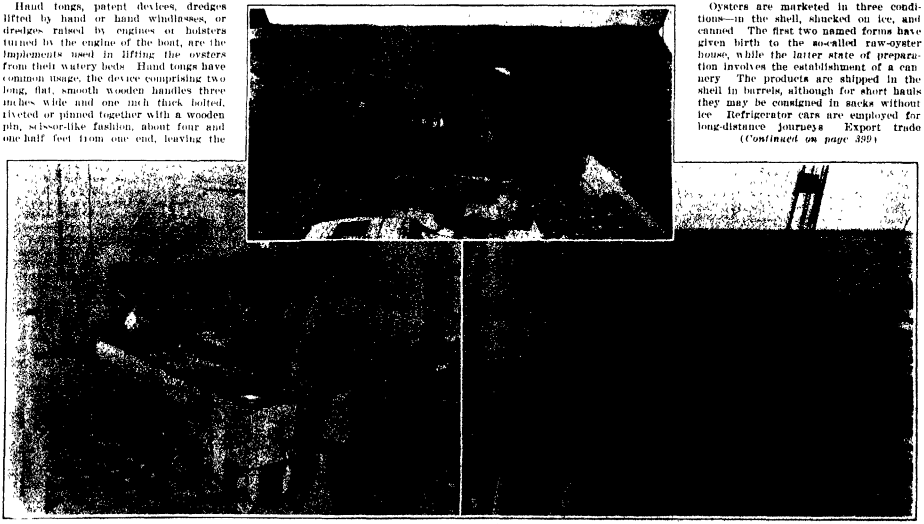
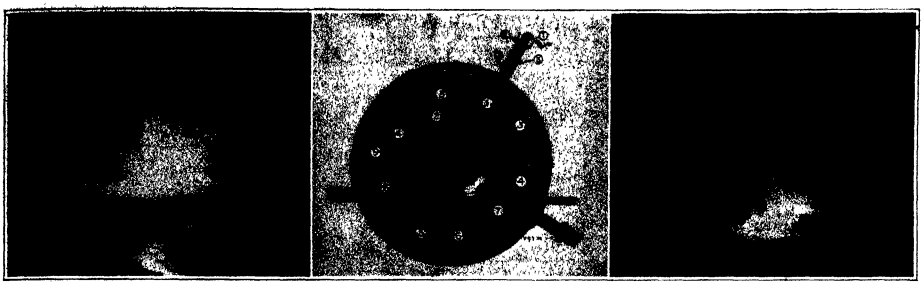


Left Washing fresh oyster meats on the skimming board, perforated to permit the water to drain off. *Right:* Lowering a dredge for oysters. From one to three of these are operated on each side of the boat. *Above:* Hand dredges and winches for hoisting them

Scenes from the Chesapeake Bay oyster industry



Left: The ordinary open arc weld, showing how the incandescent and vaporized metal is scattered *Center:* The mechanism of the newer method 1 is the steel electrode, 2 the aluminum coating, 3 that of blue asbestos, 4 the asbestos sleeve which confines the vaporized steel, 5 the electric arc itself, 6 the metal deposited by it, 7 the plate upon which is being built up the welded mass, 8 and 9 the asbestos slag lying on the surface of the deposited steel The electrode is moving from left to right *Right* Photograph of the quasi-arc weld, showing how little metal is lost and how well protected the weld is from the air *Compare this business-like bit of welding action with the spectacular but inefficient open arc at the left*

Arc welding by the recent process that conserves the metal and excludes the oxygen and nitrogen of the air

A Stride Forward in Electric Welding

ELECTRIC ARC welding is not in itself a novelty: it has had a practical place in industry for twenty years or more. In the past, however, the arc weld served principally to effect mere union between contiguous metal surfaces and was not expected to meet the alternating stresses set up by any considerable live load. The arc weld answered satisfactorily for the joining of light metal parts, but there seemed little to encourage the belief that the process could be applied successfully to the more rigorous conditions imposed in heavy steel structural undertakings, such, for instance, as in shipbuilding operations, massive repair work, etc

But the recent conflict emphasized the need of haste, the minimizing of labor, and, withal, the production of steel fabrics measuring up to prescribed standards. Then advocates of the electric-arc weld urged a wider application of that medium and many of them were sure that it could be substituted offhand for riveting which had so long held the field It is a matter of common knowledge that arc welding was by no means an unmixed blessing, in some directions it met expectations and made repairs possible in a comparatively brief while which otherwise might have taken months more to do But investigation showed that the weld introduced metallurgical modifications of a serious character—in short it was revealed that the metal of the weld was apt to be inferior to that of the bodies which it bound together.

The fact that such was the case is not hard to understand if heed be given to some of the phenomena developed within the arc and the metal immediately subjected to its fusing action The intense heat of the arc is much higher than that of the steel furnace, and by reason of this the fused metal volatilizes to a degree, not only losing a percentage of its alloys but being affected simultaneously by the free oxygen and nitrogen of the surrounding air. A knowledge of these hurtful actions naturally suggested the use of electrode rods high in carbon, silicon, and manganese content so that a portion of these alloys could be dissipated and yet leave enough of them in the deposited metal to make it at least equal in its composition to that of the steel masses which it served to unite.

This was, undoubtedly, a step in the right direction, but it still left much to chance, for it was not feasible thus to control the percentage of volatilization, nor did it prevent the propagation of weakening oxides and nitrides—the air could reach the molten metal just when it was most susceptible to the atmosphere's injurious action. Plainly, the electric-arc weld to be satisfactory called for the exercise of much anticipatory care in the preparation of the electrodes as well as a high degree of skill during execution These prerequisites stood out in marked contrast to the requirements of successful riveting But the whole subject gripped the imagination of the technicist and the inventor, and the creative mind set itself to the task of solving the problem Much has been done to make the electric arc weld adaptable to the various physical conditions imposed in the building of a ship, and it is now claimed that the arc weld can be used wherever a rivet can be driven. Not only that, but it is said that the welded joint is both better and cheaper than a riveted one

No small measure of this advance is due to what has been achieved in developing the so-called quasi arc system of welding, and we shall see that in this improvement in the art the steel maker's practices have been applied in miniature to the diminutive furnace represented by the fusing heat of the electric arc The steel maker takes care, while his metal is in a molten state, to cover it with a cloak or bath of slag which stands between the metal and the atmosphere Again, just before the steel is poured into the ingot molds, for example a small percentage of aluminum or some other deoxidizing agent is thrown into the ladle and this medium promotes the expulsion from the liquid steel of any contained bubbles of oxygen —it purges the metal and leaves it quite like a glass of soda water from which the gas has escaped Now let us see how the same results are obtained in the case of the quasi arc

To begin with, the composition of the welding rods or wire electrodes is fixed agreeably to the character of the metal surfaces that are to be united, allowing, of course, for some volatilization So far,

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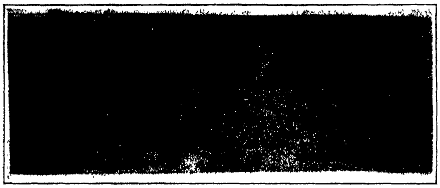


Sulfur print from polished bar welded by quasi-arc process

The machine that prints, washes and dries blue prints in a continuous operation

Recent Progress in Blue Printing

HERE is a threefold blue print machine capable of printing, washing and drying in one continuous operation Only one operator is required, who places the tracings on the sensitized paper, which is fed from a roll and carried past a bank of arc lamps when the tracings are automatically separated from the paper and deposited in a tray

After exposure the paper continues its course, first through a bath of clear water then through a weak solution of bichromate of potash or soda and again through clear water, afterward passing up over the dryer and then down to a winding device which makes a loose roll of the prints perfectly free from wrinkles or distortions and all ready for trimming

The paper is washed on the sensitized side only by means of a spray of water, which carries off all surplus chemical The drying process is uniform, and as the paper is under tension much of the usual shrinkage is eliminated and the prints brought close to true scale As a result of the passage of prints through the bichromate bath, the color is intensified and the effect of any over-exposure removed, while the washing process is materially shortened The solution is forced through a perforated pipe by means of a small pump and all surplus is returned automatically to a tank from which it can be drawn for a renewal of the cycle

Fixed Stars That Are Not Fixed

How Their Motions Are Detected by Making Them Wink at Us

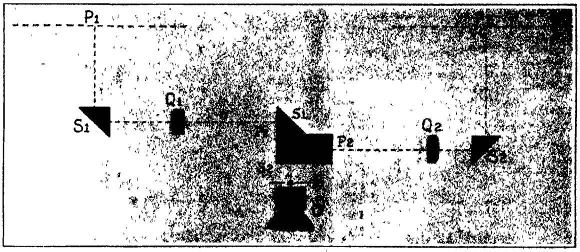
By J. F. Springer

THE astronomer uses all sorts of interesting and amazing tools, and we are quite accustomed to seeing him get results out of one of his tools which we would not have supposed were in it. A case strongly in point is the spectroscope; surely no one would have imagined, a priori, that simply by passing light through a couple of prisms it would be possible to analyze chemically the star from which it comes, and tell how fast it is moving toward or away from us. Another instance is the blink microscope of which Mr. Springer tells us here. By a simple device utilizing the principle of persistence of vision, on which the motion pictures depend, it turns out that we can tell with extreme accuracy whether a star has changed its position between the time of taking two photographs of the region in which it lies; and if it has done so, by how much. This is the tool which gives us our present large insight into the proper motions of the fixed stars—one of astronomy's most important pages and, until recently, one of its most obscure ones.—THE EDITOR.

THE fixed stars are those whose relative positions with respect to the generality of stars remain unchanged from moment to moment, night to night, year to year, and perhaps age to age. And yet there are some of these bodies whose relative positions undergo for the unassisted judgment no shiftings but which upon the application of certain instruments of precision are found to have really suffered displacement. It is generally believed in astronomical circles that *all* the stars loosely termed "fixed" are really in motion, but that these motions are difficult to detect because of the enormous distances. The matter is still further complicated by the consideration that stellar objects moving in the line of sight will show no relative displacements. However, we are fortunate in possessing the spectroscope which is peculiarly adapted to detect precisely this type of movement and to furnish a means of estimating its rate. Further, this instrument enables us to distinguish approach and recession.

Displacements perpendicular to the line of sight constitute a different problem. One might suppose that, if a star map were made today by locating the various stars by means of the positions determinable with the aid of telescopes and clocks and a second map made in a similar manner but at a later date, any displacements would be at once disclosed. The trouble with all this is that the great bulk of the stars show no change of position when dealt with thus. The variations in position are, in fact, for the most part of a truly microscopic character. Furthermore, while now and then a stellar point is found to have shifted sufficiently to make the displacement gross enough for the usual methods to detect, the number is comparatively so few as to make it well nigh useless as a means of getting a satisfactory conception of the universe of stars.

Photography has, however, come to the rescue. By means of a single negative thousands of star positions may be relatively determined. Given two negatives of the same field representing the conditions at separated moments if the one be superimposed upon the other with their relative positions fixed by matching two or three or more of the points representing stars, the generality of the one set of points will agree with the generality of the other. But attentive observation by a trained eye will discover slight displacement down to a reasonable minimum. Harvard Observatory has been conspicuously identified with this method of determining small movements perpendicular to the line of sight. A refinement upon the direct comparison of two negatives consists in comparing a negative of one date with a positive of another. Upon the negative the stellar points show as small dark points, but upon the positive we have instead small white points. The foregoing methods may be summed up as those followed at Harvard. Many hundreds of variable stars and one star of considerable proper motion are said to have been discovered by these methods at Harvard Observatory.



Light from P_1 and from P_2 passes with equal intensity into the ocular of the microscope at O. If first the one ray and then the other is cut off for periods shorter than the interval of "visual persistence," the eye will not detect the fact that it is looking now at P_1 nad now at P_2 so long as the the fields are identical. But if corresponding points of light in the two fields are not at exactly the same spot, they will "blink" as the shutter cuts off first the one and then the other

How the blink microscope reveals infinitesimal shifts of position in successive photographs of the same stars

There are very many stars and the displacements are doubtless minute for the most part, so that the Harvard procedure would probably require a great period of time and would perhaps fail to discover displacements of extraordinarily small amounts. How vast the number of stars in the heavens really is may be roughly conceived perhaps by noting that of the 12th magnitude (photographic) as many as 1,000,000 are estimated to exist, and that the number roughly doubles with the addition of a unit to the magnitude. If the Franklin-Adams scheme for the photographic reproduction of the skies is carried out to completion, the number of stars on the plates will, it is estimated, total something like 65,000,000.

What appears to be an improvement upon Harvard methods makes use of the *blink microscope*. This instrument aids the human eye to detect, upon comparing two views of the same stellar field, all displacements amounting to 1 or 2 seconds of arc, or more. While the instrument itself was invented some years ago, its practical application, for some reason or other, has not proceeded very far as yet. Nevertheless, many hundreds of plates have been examined and some tentative results already determined. First, the instrument discloses that about ½ of 1 per cent are probably stars having at least a displacement of 5" in a century. Next, the new procedure tells us, the moving stars are not traveling in random directions. Only about ten per cent have haphazard lines of movement. Of the remaining 90 per cent of moving stars, about two-thirds are traveling in a certain general direction, and the other third in the opposite direction. Again, stars of all magnitudes are moving, but the various magnitudes do not behave alike. Thus, the greatest number of displacements is to be found in stars of the 11th and 12th magnitudes. Another matter of interest concerns star clusters. Relatively to their neighbors, clusters of stars are disclosed as at rest. Still another result has to do with geographical distribution. One might perhaps have expected that the region of the Milky Way would contain a relatively large number of moving stars. On the contrary, as Mr R. T. A. Inness of the Union Observatory at Johannesburg, South Africa, tells as, moving stars are distributed rather evenly throughout the skies, but if anything they are more frequent in sparse regions. The very faintest stars—that is stars of the 16th magnitude—are, when found to be movable, situated not so distant from the Milky Way. The foregoing conclusions are to be viewed as strictly tentative. They are founded on information that is, as yet, inadequate for strong, final conclusions. At the same time, they represent inferences from a considerable number of applications of the instrument, and are to be held in memory.

When a pair of plates represents an interval of 25 years, the blink microscope shows that, on the average, there are about 3 displacements on each square degree of field. But this is not the end of the story. It has been suggested that as the plates represent longer and longer intervals of time, so the number of moving stars will increase. This is to be expected, surely. With longer and longer periods of time small movements as yet undiscernible would continually pass the threshold and come within the power of the blink microscope. Professor Turner has voiced the conjecture that the number will increase as the square of the interval. Upon the present datum that there are disclosed by a 25-year interval three moving stars in every square degree, the whole sky should yield, according to Mr. Inness, some 200,000 moving stars. Adopting Professor Turner's rule, one may readily conclude that for a century, the yield should be 16 times the former, or 3,200,000. Even so, the number of stars actually in the fields disclosed would be far greater, being a total of some 16,000,000. However, by the time the century is completed, the blink microscope may very well have been superseded by something far better, or some other method than the comparison of photographic records may have been devised for the purpose of informing us as to displacements perpendicular to the line of sight. On the other hand the blink microscope is probably the best means at present available.

The blink microscope appears to have been a development of the stereocomparator. When a pair of plates of the same field is examined by means of the latter instrument any object of the field which has shifted its position will stand out stereoscopically. That is, one will be able to pick out the object because it is now appearing in three dimensions instead of two. This, at any rate, is the theory of the matter. It is said that, in practice, not only do the objects which have shifted stand out stereoscopically but many others do so as well. It is suggested that this may be due to some small distortion of the image, or to the eye itself. If the eye is responsible, then the result may be due to some physiological "expectation" in virtue of which small objects are seen as more distant than the large ones. "Suspicious objects are, however, noted at the stereocomparator and are then measured to find if the displacement is real."

It will be gathered from the foregoing, perhaps, that the stereocomparator lacks something of perfection. The blink microscope improves upon it because it depends upon more suitable principles. The latter instrument is not binocular at all. Stereoscopic effect is given up. But the two plates representing the beginning and end of a time interval are set in the instrument as if it were expected to view them stereoscopically. Here we have a distinct departure from the

(Continued on page 400)

***Left:* Working platform, near one of the towers of the Williamsburg Bridge, at a point 300 feet above the river; also the machine for winding the wire on the cables. *Right:* Near view of the electrically-operated trolley, showing the wrapping wire passing from the spool to the cables**

Re-Covering the Cables of the Williamsburg Bridge

IN order to give the wire cables of a great suspension bridge such as the Williamsburg Bridge across the East River, New York, a permanent lease of life, it is necessary to protect them absolutely against the weather. Not a drop of water nor any moisture laden air must be allowed to get at the mass of many thousands of tautly strung wires which compose each cable. Otherwise, rust would set in and would be progressive to the point at which rupture would occur

The Williamsburg Bridge has a main span across the river which measures exactly 1,600 feet from tower to tower. The bridge is hung upon four cables, each of which consists of 7,696 steel wires 3/16 of an inch in diameter. The diameter of each cable, as assembled, is 18¾ inches When the bridge was being completed, now some twenty years ago, it was decided not to follow the method of protection adopted in the old Brooklyn Bridge, which consisted in wrapping the cables with wire Instead, they were thoroughly soaked in a bituminous material and four wrappings of canvas heavily coated with the same material were wound around the cables. Outside of these was placed a sheathing of steel plate 1/16 of an inch in thickness Now, in spite of repeated painting, this steel sheathing has corroded so badly that it was decided to remove it, together with the canvas wrapping, and substitute in its place a wrapping of 1/8-inch steel wire Our photographs show the methods by which this work was done. The first step was to build a working platform beneath each cable The platform is suspended by steel wire slings, one at each panel point of the main floor suspenders. These slings make fast to stirrups which hold a series of 8-inch floor beams, one at each panel point Upon these are laid 3-inch by 12 inch longitudinal stringers, to which is nailed down the flooring of 2 inch by 12 inch planking This construction affords a solid floor 8 feet in width, which gives ample space for the workmen to stand on each side of the main cable.

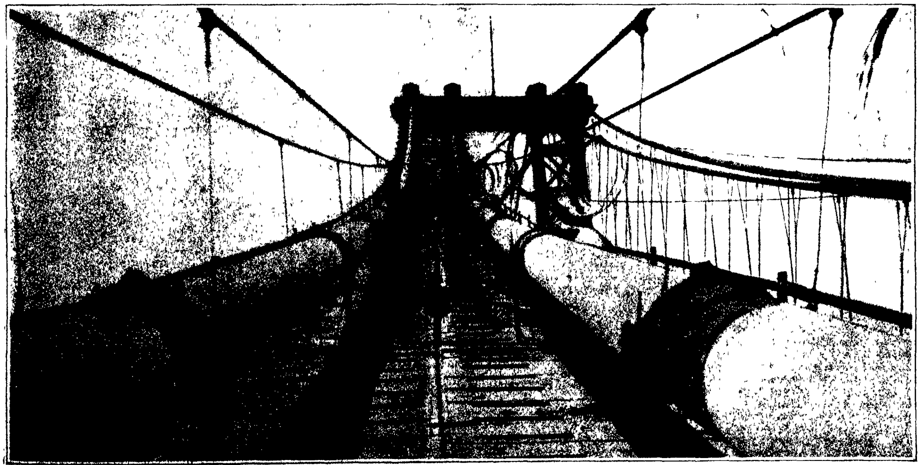
The wire winding is done by means of the very ingenious automatic wire-winding machine, featured in our cover illustration and also shown in our engravings, which consists of a trolley-way, *B*, carried upon uprights, *K*, which are securely bolted to a series of saddles that are themselves bolted to that part of the cable which has already been wire-wound Running in this trolley-way is a trolley, *C*, upon which is mounted an electric motor whose pinion, *D*, drives a large spur wheel, *E*, which is mounted upon and rotates around that part of the cable, *H*, which has not yet been wrapped with wire. It will be evident that since the trolley track and trolley are mounted rigidly upon the cable, the effect on starting the motor is to cause the large spur wheel to rotate about the cable as an axis

Now upon the spur wheel is mounted a spool of wrapping wire, *F* The wire passes from the spool over an idler, *G*, and then down to the main bridge cable The spool, *F*, is provided with a friction clutch by which the desired amount of tension (500 pounds) is secured in the wire as it is wound around the cable.

In order to make a thoroughly water-tight joint where the wire winding meets the steel saddles, or clamps, from which the floor suspenders are hung, a special spur wheel is substituted for the one shown in our picture This is provided with a tool rest, which holds a tool by which a recess is cut in the clamp deep and wide enough to admit four of the wire windings, which are thoroughly caulked in place with lead wool, thus preventing the entrance of moisture at this point.

After the old canvas protection has been stripped

(*Continued on page 400*)



Two of the Williamsburg Bridge cables, with the temporary working platform suspended below them. All four cables are being wrapped with 3/16 galvanized wire, whose total length is 960 miles

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Degumming of Silk

THE *Color Trade Journal* has offered the following as a successful method for degumming silk:

"For fifty pounds of silk use two pounds of neats foot oil, one pound of olive oil soap, two ounces of washing soda and one ounce of salt. The salt and soda are dissolved in a small amount of clear water at not over 70° F. Boil the soap in twelve gallons of water until dissolved, then add the neats foot oil, stirring well to make an emulsion, then pour into sixty gallons of water part of which is the salt and soda solution. Keep this well agitated until the silk is put in, otherwise the oil will rise to the top, in which case it can never again be properly mixed. Thoroughly immerse the silk, which has been opened from the tight skein formation as taken from the "book," but not shaken out, and soak from eight to ten hours. Remove the silk from the bath and extract by whizzing in the centrifugal."

The Effect of Heat on Glue

THE Forest Products Laboratory in its experiments on ply-wood has determined the effect of oils and heat on glues used for such joints. The experiments included animal, vegetable, blood albumen and casein glues. Specimens were immersed in gasoline and various oils for a year, and tests at various intervals indicated to what extent the glues were weakened by this treatment. During the forty-five weeks' test the wood absorbed 60 per cent of its original weight in engine oil and 70 per cent of gasoline without any noticeable swelling of the wood occurring, while all glues weakened during the early part of the test. The total loss of strength in any case was so small as to be negligible under service conditions.

The experiments showed that continued heating will reduce the strength of animal glues and that a veneer glue lost one half its joint strength during the first seventy hours of heating at 160° F. A lower temperature produces conditions favorable for bacteriological and chemical action, and the most favorable temperature is found to be 140° F. Even at this temperature long heating produces loss of strength. When open glue pots are used the loss in strength is apt to be concealed because of the increase in viscosity due to the evaporation of the water, but obviously such concentration is expensive and covered glue pots have a distinct advantage. Even with such pots long continued heating is to be avoided if high strength is to be maintained.

Selenium Oxychloride

AT the St. Louis meeting of the American Chemical Society last spring Prof. Victor Lenher, University of Wisconsin, announced that he had found selenium oxychloride to be an unusual solvent, the limitations of which had not yet been worked out. It was reported to be unusually good as a solvent for organic substances. Since then progress made with this material has justified the direction of the efforts of some twenty research students toward perfecting details of manufacturing the solvent on a large scale and also in making further determinations regarding its characteristics and reactions with a great number of substances. At present the indications are that in selenium oxychloride both the research and the technical chemist will find a new reagent of unusual value, and the refiners of copper will no doubt find a considerable outlet for their selenium in this direction. The effort to find further uses for selenium is being continued by a committee appointed for that purpose in the Division of Engineering of the National Research Council.

Some of the New Applications of Sulfur in Agriculture

THIS is the subject of an interesting article by Doctor J. G. Lipman in a recent issue of the *Chemical Age*. Doctor Lipman emphasizes the usefulness of sulfur as one of the ingredients of plant food, as a means for making available other plant food ingredients, and as a soil amendment. We are reminded that sulfur is one of the necessary ingredients if we are to have plant growth, the need for sulfur varying with the character of the crop. Cereals require from four to seven pounds of sulfur per acre each year and the legumes because of their higher content of protein need even more of the element. A fair crop of clover will require from eight to fifteen pounds of sulfur per acre and alfalfa may require more. A heavy crop of cabbage will need as much as thirty or thirty-five pounds of sulfur per acre. Much of the sulfur for crop food is supplied by the soil itself which contains from three to five hundred pounds per acre considering the soil to a depth of six or eight inches. The atmospheric precipitation provides from six to ten pounds per acre each year and larger quantities are washed out of the air adjacent to large industrial centers using sulfur-bearing coals. Notwithstanding this large amount of sulfur it is to be remembered that it is constantly being removed in the form of water soluble sulfates and by the crops themselves so that in time it will become necessary to replace it as is the case with any other essential in plant food.

In increasing the availability of other plant foods sulfur finds a place particularly in the manufacture of sulfuric acid used in the manufacture of potassium sulfate, ammonium sulfate, and the phosphate fertilizers. As a soil amendment sulfur acts to improve the texture of the soil and to correct excessive alkalinity.

The Chemist in Public Life

THE position of the chemist in our economic and political life still seems to be uncertain although many have believed that the war served to emphasize the importance of that profession. In a recent number of *Chemical and Metallurgical Engineering* an editorial called attention to the relative importance of cooks and chemists to the Civil Service Commission of New York City which had vacancies in the Service, one of which offered twenty-five hundred dollars per year for a cook and in the same list there appeared an opportunity for a chemist skilled in food and drug examinations for which the Commission was willing to pay eighteen hundred dollars per annum. The same list also included an opening for a laboratory assistant in pathology at nine hundred and fifty dollars per annum. Contrasted with this is the outcome of last year's Republican primary election for Senator in North Dakota where Doctor E. F. Ladd, a man prominent in the official Association of Agricultural Chemists and President of the State Agricultural College of North Dakota, was nominated, winning over the Senator up for re-election by over thirty five hundred votes. Doctor Ladd has long been prominently connected with the enforcement of the pure food and drug legislation in his State, at one time fighting against tremendous odds. Doctor Ladd has also been prominent in work of sanitation and the author of a treatise on the analysis of paints. His election in November was more or less of a foregone conclusion.

Doubtless the chemists of the country will be particularly interested in Doctor Ladd's work and will feel that there is at least one member of Congress who will thoroughly understand their problems and be inclined to give them a complete measure of sympathetic consideration.

Decennial Celebration of the Forest Products Laboratory

A LARGE number gathered in Madison, Wisconsin, in July of last year to celebrate the decennial of the Forest Products Laboratory. The percentage of lumbermen and other business men willing to take their time to attend the celebration was encouraging as indicating an appreciation of the type of work which the Laboratory has carried forward these several years. Perhaps the most appreciative compliment lies in the fact that several foreign countries have used this Laboratory as a model in installing similar organizations who work upon their own problems. These countries include Canada, Australia and Norway. The importance of forests to our national prosperity was emphasized at all the meetings as was also the necessity of fully utilizing the products of the forests. In outlining some of the future problems, Mr. C. P. Winslow, the Director, called attention to the desirability for a thoroughgoing study of glues and other adhesives to the end that smaller pieces of wood might be assembled in a way to make them satisfactory for use where much greater lengths and thicknesses are now specified. The Laboratory accomplished a great deal in this field while working upon aircraft and shipbuilding problems during the war.

Following the decennial celebration a conference was held on reforestation by the various wood-using industries in coöperation with representatives of the Federal and State forest services and the lumber producing interests. This program included a comprehensive presentation by W. B. Greeley, Chief Forester of the United States Forest Service, on what should be our national forest policy. The other items on the program discussed what has been done on reforestation, lumbermen's interest in the subject, and the reasons for the coöperation on the part of the wood using interests in reforestation. The importance of fire and its thorough control was especially stressed, fire being charged with from seventy-five to eighty-five per cent of the annual losses in the United States. The relations between the Federal, the State Government, and the private timber owner require considerable study if a satisfactory arrangement is to be obtained. Taxation is another perplexing problem.

Some of the points made in the conference were that we are cutting our forests four times faster than they are now growing, that there are in the United States three hundred and twenty-six million acres of cut-over forest lands bearing no saw timber, and that of our original forest area of eight hundred and twenty-two million acres only one hundred and thirty-seven million or less than twenty per cent remain as virgin forests.

Registration of Baking Materials

THE American Institute of Baking has perfected a plan for the registration of baking materials by which approved products will be given a certificate and a serial number, and so accorded recognition. At first this system will be limited to two lines of supply, namely, the malt product and the shortening agents. Later on, sugars, glucose products, yeast and yeast foods, salt, milk products and other raw materials for baking purposes will be certified. This plan grows out of the increasing number of requests received by the Institute for the analysis of raw materials, and the determination of their quality and adaptability to the particular purpose for which they are offered. These inquiries have come in not only from the baker but also from the manufacturer of the products who is anxious to know the exact quality of his own products and what may rightly be claimed for them. There has been such an increase in the variety and number of specialties offered the baker that it has been increasingly difficult for him to select the ones which have merit for his special purposes and to exclude others which do not meet his own requirements. While many products are of excellent quality the claims made for those which are not are sometimes not only exaggerated but false and misleading. The new plan should work to the advantage of the manufacturer as well as of the user and the public.

The Problem of the World's Supply of Energy

THIS is the subject of an interesting discussion by Doctor Arrhenius several months ago. It is pointed out that the early exhaustion of our fossil fuels will require the use of such other sources of power as water, wind, and sun. Doctor Arrhenius argues that the continual increase of carbon dioxide in the atmosphere will reforest the temperate zones and eventually drive civilization back to its birthplace—Mesopotamia, the Mediterranean, Central America and Peru. The estimated life of the coal fields is put down at fifteen hundred years and he believes it to be clear that we must soon ration our coal and substitute as far as possible other sources of energy. In view of the greatly increased uses of petroleum, it is considered doubtful that mineral oils will constitute an adequate auxiliary supply and the necessity for developing water powers as rapidly as possible is emphasized. The power from wind mills and solar energy is discussed from the standpoint of the limitations due first to the great variability of the winds and second to the geographic areas, choosing those where solar engines might be used to advantage because the sky is not covered over the greatest part of the year as in the Congo and the Amazon and the temperate zones.

Professor Arrhenius calculates that the increase of carbonic acid will give the whole world a more uniform and warmer climate. The burning of coal, therefore, will cause our climate to gradually approach that of the Tertiary Age. Agriculture will be benefited and reforestation will be stimulated.

A Concrete Pit for the Garage Repair Man

ONE way to avoid the disagreeable business of squirming about on your back beneath a crippled car is to have a cradle of some sort on which to turn the car partly over, so that its underbody is exposed to the eye and hand of a workman in normal attitudes. What seems to be just as good a procedure, if not a better one, is found in a California garage from which the accompanying photograph comes It appears to be borrowed from railroad and trolley repair-shop practice, where it is entirely the regular thing to have pits beneath and between the tracks for the convenience of the man who has to tinker with the parts of the mechanism that are not easily accessible from above. There doesn't seem to be any reason why the same thing should not be done in a garage, and here is one in which it is done. It will be observed that the fortunate worker in this pit, with his fan and his portable electric light, has all the comforts of home right at his disposal, as well as the comforts of a well ordered workshop as represented in his little workbench and vise.

Those Who Live in Glass Houses

IN a land where everything except the climate and the scenery has to be brought several thousands of miles by ship and pack-train, it is a matter of obvious necessity that every little thing which is finally brought in in spite of these obstacles shall be utilized for all there is in it. This applies as well to packing cases and empty bottles as it does to their contents. So we have an ingenious Alaskan of Moosehead who instead of allowing his discarded bottles and those of his neighbors to go to the dump heap, has built him a shack of this unusual raw material. The photographer suggests that this looks as though there were no prohibition in Moosehead, and that if this is really the case, addiction to the juice of the grape is a real advantage to the proprietor of the mansion of the picture, to the extent that the more he drinks the sooner his house will be completed

Putting the Sound Where it is Wanted

A NEW YORK dance-hall proprietor who was having trouble with the acoustics of his establishment and experimented with a number of devices designed to make his orchestra properly audible to all his patrons, finally struck the right combination in a composition board shell as shown in our picture. This sounding board is built in the shape of a huge clam shell, 21 feet wide and 13 feet high, and with a swell of 6 feet from back to front It projects a foot and a half in front of the band-stand, thereby enabling the music to hit the shell and be projected from it without coming in contact with the ceiling, which it was determined had been the cause of all the trouble Dancers in the most remote corners of the hall can distinguish clearly the sounds of the several instruments Since its installation this sounding board has been inspected by many theatrical architects and builders in search of suggestions.

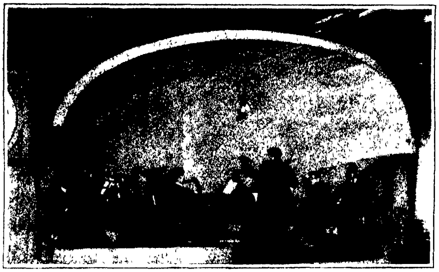
Saving Mine Timbers From Decay

ENORMOUS quantities of valuable timbers are being placed in the coal and metal mines of this country without any preservative treatment against decay. That the life of these timbers might be greatly lengthened by the injection of certain chemicals has been proved by the U. S. Forests Products Laboratory in numerous service tests. In 1910 the laboratory installed in an Alabama mine untreated timbers and timbers which had been treated with coal-tar creosote. Ten years later all the untreated timbers had been removed because of decay, while 80 per cent of the creosoted timbers were still sound and none had decayed to a point where removal was necessary This is *only one of the many records obtained* by the laboratory which should induce every mining company to install some sort of wood treating plant

At least three preservatives have been found suitable for mine work These are coal-tar creosote, zinc chloride, and sodium fluoride Creosote is the most effective in preventing decay Timbers thoroughly impregnated with it are likely *to resist decay until they are crushed or* worn out Occasional objection is made to the possible fire hazard of creosoted wood, but long experience indicates that the additional fire risk is very small Zinc chloride and sodium fluoride are odorless, and if anything they tend to reduce the inflammability of wood They are cheaper than creosote, and although they do not give such permanent protection they greatly increase the life of timbers Coal-tar creosote may be applied by the brush, dipping, open tank or pressure methods Zinc chloride and sodium fluoride may be injected by the steeping, open tank, or pressure methods The cost and effectiveness of the methods of treatment increase in the order given The saving possible with any of them is so great that it will pay every mine to adopt the use of some preservative on permanently located timbers

A handy and well-equipped pit for working underneath the automobile

An Alaskan shelter built of empty bottles



A thin sounding board shaped like a clam shell solved the acoustic problems of this orchestra

The machine which indicates the gentleness—or otherwise—with which the hairdresser goes about her task

White Yolks of Eggs

THE trick of obtaining eggs with white yolks has been turned, according to *Umschau* by Palmer and Kempster, *two poultry breeders*

The yolk derives its fine, yellow color from a natural dye, carotin, which also constitutes the pigment of carots This carotin produces as well, the intense yellow coloring in the beak, the earlaps and the legs of leghorns an Italian breed

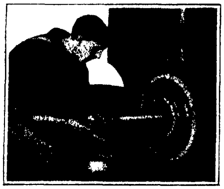
By eliminating all carotin from the feed it was possible to produce perfectly white leghorn hens, and these hens in turn laid eggs with white yolks their fertility was not, however limited in the least The frequent disappearance of the yellow pigment from earlaps, legs, etc, which has been observed in leghorns during the laying period, is caused by the fact that during this time carotin is excreted, first of all, in the yolk In the case of laying hens which produced eggs with white yolks, the carotin contents of the different feeds could very easily be examined It proved that carotin is contained in greatest amount in Indian corn and in green feed

A Testing Machine for Hair Combers

IS *your barber in the habit of combing* your hair in such style that the comb bites a piece out of your ear? Are his scissors afflicted with blunt regions, to have your hair caught in which means to have it pulled out by the roots? When he applies his massaging fingers to your face, do they feel like massaging fingers, or do they feel like a crippled plow working over a stony hillside? If the answers to these or any *similar questions are to his* discredit, perhaps you can persuade him to attend the school for hair-dressers which has recently been established in Berlin At this place it is the aim not merely to teach the students what to do, but to instruct them thoroughly in the best way to do it Our photograph shows, for instance, a test which they all have to meet before they are judged to be competent hair-dressers This machine is specially designed to test the user's ability to comb hair without pulling or jerking or breaking it By recording the tension at all times during the combing, it gives a complete indication of the manner in which the wielding of the comb progressed

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



An electric truck in which driving shaft may be removed

An Electric Truck with Removable Driving Shaft

AMONG the several new features in a recently-introduced electric truck for factory transportation, is a removable driving shaft, as shown in the above illustration This truck makes use of a single reduction worm drive The motor drives the worm through a flexible coupling The differential, the worm and the worm gear are enclosed in a cast steel housing A four-pinion differential is used The full floating driving axle may be removed without disturbing the wheels, for examination and repair. No weight is carried by the drive shaft, and ball-bearings are used throughout the power unit

A New Idea in Canal Boat Haulage

SOME time ago we illustrated and described a novel type of electric mule employed in hauling the barges through French canals More recently there has come to our attention the Cheneau system of electric haulage, which is now in use on the Saint-Maurice Canal and which so it is reported, proves quite satisfactory

Instead of resting on the ground, the Cheneau tractor is suspended from a stout cableway that parallels the canal The weight of the tractor serves to give it the proper tractive effort on the cable, while a separate wire serving as a trolley wire supplies current, the return being through the cable The Cheneau tractor weighs 1,320 pounds and is driven by a 10-horsepower, 500-volt motor completely enclosed in the case. Two vertical wheels rest on the cable and support the tractor, while four horizontal wheels, arranged in two pairs, serve to squeeze the cable and, being driven by the electric motor, form the tractive wheels

This novel arrangement of the wheels and the towing cable has been figured out to such a nicety that positive traction is assured under all conditions. The motor is controlled from the barge, if desired, by wires running through the hauling cable.

Cheneau system of hauling canal boats in France. Note that the tractor is this case is suspended from a cable

Something New in Phonograph Motors

AN engineer in the large electric works at Fort Wayne, Ind., Chester I. Hall, has developed a motor to be used on phonographs, which meets all the requirements and which presents several interesting and novel features in design and operation.

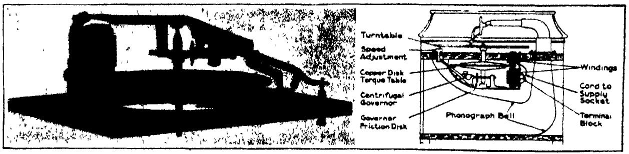
The motor is a small induction motor, somewhat similar to those used as the motive power of induction watt-hour meters It consists of a rotating element fastened to the shaft of the turntable and running between two field coils The rotor is formed of a ring of copper of about 6 inches inside diameter, and about 1½ inches wide, supported from the main shaft by a cast aluminum spider.

The rotor revolves through a shifting magnetic field produced by field coils wound on laminated magnetic circuits Thus, since the revolving element is directly fastened to the main turntable shaft all necessity for high speed gearing, belting or friction drive is entirely eliminated. The lower bracket supports a governor which is geared to the main shaft by a worm gear.

It was found quite difficult to eliminate the noise caused by the magnetic hum, due to the sixty-cycle circuit, but this was accomplished by a proper design of the supporting brackets and spider, as well as by the elimination of vibration in the motorboard itself.

The simple construction, few moving parts--two only, as a matter of fact—the absence of sliding contacts and the small amount of power consumed in bearing friction, all combine to give the motor a life that is probably limited only by the life of the insulation

If the claims made for this phonograph motor are substantiated in actual practice, it appears that this invention marks a distinct step forward in the phonograph art. Heretofore it has been well-nigh impossible to obtain a truly silent mechanical or electric motor, due to the fact that the high speed driving element has had to be geared down to the 78 turns, more or less, of the turntable.



Induction motor for phonographs, shown bottom side up, and the elements of this novel motor installed in a typical phonograph cabinet

A Gas Stove That Retains Its Heat

OWING to the high price of coal in France, illuminating gas is so costly that consumers are endeavoring in every way to curtail consumption. Indeed, the city of Paris recently held a fuel-saving exposition, to which manufacturers and inventors of stoves and cooking devices were invited in order that they might make their devices public.

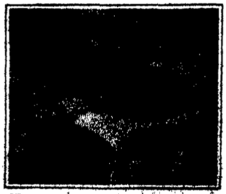
The accompanying illustration shows a new type of gas stove which attracted no little attention and was the subject of favorable comment at the fuel exposition. It appears to give a remarkably economical performance. Instead of having burners in the open air, as is the standard practice, this new gas stove has its burners enclosed in a heating chamber lined with refractory brick. Openings are provided at the top of the heating chamber, so that pots and pans can be heated. In this manner the calories generated by the gas flame are not permitted to escape directly into the kitchen, but are directed against the pots and pans and thus made to do useful work One burner serves for three or four pots and pans in this novel arrangement.

Copyright, Keystone View Co.

New gas stove developed in France and now being used because of its economical operation.

Clothes Pressing Reduced to Simplest Terms

IN order to facilitate the pressing of clothes in the average household, Jas. H. McManemin of Wilmer, Texas, has invented the simple device shown in the accompanying illustration. Pressing of men's suits, ladies' coats and suits, serge and other heavy dresses, and other garments in general is brought about merely by placing a piece of heavy wet ducking over clothes and resting device thereon Current is then turned on, and the weighted electric heater left in place until the duck is dry. The pressing calls for no further attention, so that other household duties may be attended to while the clothes are being pressed into shape. The device weighs but sixteen pounds, is provided with handles, and measures 10 by 17 inches.



Weighted electric heater resting on wet duck covering and clothes to be pressed

Keeping Our Railroads Up to the Mark

(Continued from page 384)

of six is needed, while the triple unit calls for a force of ten. Four of these do the drilling, two take care of the bonding, one fixes the "bootleg" wires which connect with the source of current, and each of the cars has its operator. Even so, this is nine men fewer than are demanded when dealing with the same task by the more general method.

What is also decidedly suggestive, the air-driven drills are found to stand up to service with less frequent replacements and a smaller number of breakages. It is authoritatively said that in the case of the hand tool not more than 14 holes could be drilled on an average with a single drill, whereas the far better performance of the pneumatic apparatus means a saving in drills, in the course of a day's work, of something like $50. As a matter of fact, the 3-car equipment drilled 1,672 holes in the course of 7½ hours, and the single-car unit has made 780 three-eighth-inch holes during a span of a trifle more than 8½ hours. Indeed, neither of these bonding outfits could operate to capacity, for, on the occasions referred to, they were hampered by the slower advance of the rail-laying crews. In this we see the tables turned.

Pneumatic appliances are likely to do still more in the way of speeding up rail laying and making or maintaining the roadbed in a fit condition for heavy traffic That is to say, air-driven wrenches are admirably suited for screwing up and tightening track bolts where the rails are bound together by fish-plates, and once the rails and ties are in place, the pneumatic tamper is of marked value in packing the ballast about the sleepers. So much superior is the air-tamper's work over that of the usual pick that an expert engine driver has declared that he can tell instantly when he is passing over a hand-tamped or a pneumatically-tamped roadbed. The latter, so it seems, gives a firmer support to the speeding train. Not only that, but the workman doing tamping with the pneumatic apparatus can accomplish more with less bodily stress In part, this is due to his being able to hold an easy upright position, while when tamping with a pick he must bend over and keep his nose pretty close to the ground.

In conclusion, the portable compressor plant for railway work is equally useful in furnishing motive energy for pneumatic tools designed to drive screw spikes, to bore holes in the wooden sleepers, to drill through the rails in close quarters and awkward places, and to operate grinders for finishing off switch points. In all of these services the aim, of course, is to accomplish results quickly and with the least labor permissible. The fact that we possess these various apparatus is evidence that the roadways of our vital trunk lines can be rapidly whipped into shape to deal with the greatly increased volume of traffic which they will inevitably be called upon to handle before long.

Canada's Big Oil Strike

(Continued from page 385)

called it, is not uninteresting. Geologists have known of the existence of oil in the Mackenzie district for many years. Parties who went in to the Yukon by that route during the Klondike rush used to make use of oil shale for building their fires, and seepages were visible everywhere in the district, but it seems to have been to the tar sands that geologists looked as a source of potential wealth. A practical demonstration of the value of the tar deposits was made in 1915, when one of the Edmonton streets was paved with material made from the McMurray deposits. Just before the war Germany had become interested in the proposition, apparently with a view to securing an unlimited supply of tar for the benefit of the [illegible] industry. A number of German chemists visited the deposits, and one of them took out a lease, but he died on board ship on his way home; the war followed soon after, and put an end to German participation in the development.

The amount of tar sands available for reduction is estimated by the experts of the Department of Mines at billions of tons. The hindrance to their development has been the scarcity of fuel, but it is expected that this can be overcome by the utilization of natural gas, of which there is an abundant supply at the Pelican rapids, on the Mackenzie, 150 miles south of McMurray. An enormous volume of gas was burning there for over twenty years, and the Government had it capped a year or two ago. The recent advance in the price of crude oil has made the matter of reduction of the tar sands worthy of consideration. Another use which will probably be made of the tar from these sands is as a binding material for the coal briqueting industry which the Scientific Research Council is endeavoring to establish in the low grade lignite coal fields of the west It is doubtful if any practical method of extracting oil from the tar sands on a commercial basis has yet been found, although the laboratory experiments have created great hope that one soon will be

The most interesting phase of the new discovery for some time to come will be, as was the case with the Klondike discovery, the enterprise, romance, and danger connected with reaching the new fields. There are several alternate routes, as there were to the Yukon, each of which has its advocates and each of which will certainly have its patrons, but since the Yukon days a new factor in transportation has entered the field, and of this apparently some at least of the fortune seekers will take advantage. Airplane routes are being advertised and several aerial transportation companies are already in the field.

For the present, transportation will be principally by dogsled, as navigation will not be open until late in June It is not expected that many will attempt to make the journey, however, until navigation opens At the best, it is for part of the way a rough and strenuous trip, and under winter conditions is impossible to any but the most hardy and experienced Some of the sourdoughs and hardy old mushers of British Columbia and Dawson City are said, nevertheless, to be preparing to make the long overland trek from that region

With Edmonton as a starting point, there are several alternate routes, each of which will no doubt be tried as soon as navigation opens The most direct is almost due north, the Athabasca route Of this 200 miles is by rail, but a portion of the road is in very bad condition owing to muskegs, and presents difficulties There is then a journey of 285 miles by steamboat, to Fitzgerald. The last stage is a sixteen-mile portage to Fort Smith, the head of steamboat navigation on the Mackenzie From this point the distance is the same by whichever preliminary route is taken, or about 850 miles to Fort Norman, a total by the Athabasca route of roughly 1,500 miles The Peace River route is two or three hundred miles longer, but is said to be the more speedy on account of the better and longer railway journey at the beginning. There is first-class railway accommodation to Peace River, 312 miles; thence the route is by steamer, with one short portage of four miles, in addition to the one of sixteen miles at Fitzgerald, common to both routes.

Motorizing the Rural Church

(Continued from page 385)

complished in this change is the fact that church membership is constantly increasing as the number of rural churches decline.

With the automobile came good roads,

(Continued on page 397)

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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRPLANE —H. I. Rose, 13 13th St., College Point, L. I., N. Y. An object of the invention is to provide for the foot control of the steering rudder lift rudder and ailerons of an airplane thereby enabling the pilot to have his hands free for any emergency a more specific object being to coöperate in foot controlled mechanisms with the usual hand lever thereby giving an increased margin of safety in the event of injury to the pilot's arms or legs, or injury to the foot or hand control elements

Pertaining to Apparel

COAT —M. Berkwits, 62 W 14th St., New York, N. Y. The invention has for its object to provide a coat arranged to permit the wearer to wear it with either side out in one position providing a plain exterior and when worn reversed presents a fancy appearance Another object is to render the coat exceedingly strong and durable and to insure a proper fit without danger of bulging parts

SOFT COLLAR FASTENER —M. W. Reese, 3216 Myrtle Ave., Omaha, Neb. The invention particularly relates to linked clamps for engagement with the meeting edges of the outer fold of a soft collar whereby said edges are secured together after the tie has been applied The principal object of the invention is to prevent relative twisting of the clamps whereby to minimize the amount of time and effort required in the application of the fastener to a collar

LOCKED SURFACE PIN —O. Kartzmark, 102 Richard Place, West Haven, Conn. The invention has particular reference to buckles, pins or clasps adapted to be detachably secured directly to the surface of a garment with an action somewhat similar to a cat's claw, the manipulation of the pin being readily effected by one hand A still further object is to provide a pin or clasp for the attachment of elastic straps or the like for sleeves or hose supporters or other analogous uses

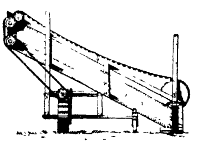
Electrical Devices

ELECTRODE TERMINAL — H. M. Koretzky, c/o Bright Star Battery Co., 310 Hudson St., New York, N. Y. The invention more particularly relates to dry batteries in which it is often difficult to provide a sufficiently tight contact to insure perfect results The invention is especially directed to providing a terminal to be associated with a central electrode, such terminal insuring at all times an intimate contact between the active element and its body whereby a full production of current will be insured

COMBINED FEEDER AND MAGNETIC SEPARATOR —H. Converse, Winona, Miss. The object of the invention is to provide a combined feeder and separator especially adapted for use with cotton seed, grain or similar material, and which is adapted to be associated with the chute of any machine or system utilized to convey seed or grain which is effective when so associated to control the feed of the fluent material, and to separate metallic particles therefrom

Of Interest to Farmers

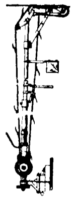
HAY ELEVATOR —J. I. Wallace, R. F. D. No. 2, Huston, Idaho. An object of the invention is to provide a side delivering hay elevator in which the hay or grain is taken from a side delivery rack device and delivered without waste to a wagon. Another object is to provide an elevator in which a pair of endless drapers are used to take and convey the load laterally of direction of travel and dump the same into a delivery wagon or receptacle



A REAR ELEVATION OF THE DEVICE

PLOW —A. Agneni, Rome, Italy. This invention relates to a plow in which the point is made movable The object is to produce a plow by means of which the plowing is facilitated owing to the fact that the breaking of the ground is effected by the movable point under the action of a blow delivered against the point supporting member said blow being obtained by means of a set of rotable hammers mounted upon the plow frame

SHEAF HOIST —E. Eberly and W. G. Fretrow, Mechanicsburg, Pa. The general object is to provide a sheaf hoist arranged with sheaf throwing means at the upper end of the hoist for taking the sheaves from the elevating conveyor and throwing them to a mow as well as with respect to other features including a novel means of mounting the hoist to be laterally swingable when desired through an arc to variously direct the sheaves to the mow



A SIDE ELEVATION OF HOIST AS INVENTED

WEED CUTTING APPARATUS —W. E. Abernathy, Great Falls, Mont. The purpose of this invention is to provide an adjustable apparatus for cutting weeds in the field, the device having a plurality of cutting disks which travel in the ground in such manner as to be rotated by their coaction with the soil, thus eliminating the necessity of employing additional motive power for the propulsion of the disks

GATE —R. H. Hearn, Dyer, Tenn. This invention has for its object to provide a gate especially adapted for preventing the passage of stock when the gate is closed, and so arranged that it may be opened and closed from either side The gate consists of a *series of plates so arranged that they may* be swung into the same plane, or in parallelism with each other together with means for operating the same and for holding the plates in closed position

Of General Interest

CAMP STOOL. —B. C. Y. Brown, 1155 E. Vernon Ave., Los Angeles, Cal. An object of the invention is to provide a collapsible camp stool, embodying features of construction, which tend to make the stool stronger and durable, yet light in weight. A further object is to provide a camp stool which is comparatively simple in construction and inexpensive to manufacture

PHOTOGRAPHIC VIEW FINDER. —F. M. Barney, Elm Creek, Neb. The invention has for its object to provide efficient means for aiding the operator in symmetrically positioning the view or picture upon the film or plate. A further object is to provide a view finder for *taking other than square pictures,* in which the visible field presented by the view finder will correspond as regard to shape, position and proportion with the view impressed upon the film or plate

ENDLESS TRACK GUN CARRIAGE —E. Rimailho, 12 Rue de la Rochefoucauld, Paris, France. Among the objects of the invention is to provide a construction in which the apparatus for traversing the gun by hand is intimately connected with the service of the gun by the fact that the hand wheel is placed on the gun carriage near the sighting and elevating devices, to be worked by the same gun layer to simplify the operation of pointing the weapon

DISPLAY DEVICE —A. G. J. and H. B. Drosin, 29 E. 14th St., New York, N. Y. An object of the invention is to provide a device which is adapted to be supported in the windows or doors of restaurants and like places to display the menu A further object is to *provide a device which is neat and attractive* when in use, and which will permit of ready attachment and detachment of the menu card.

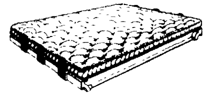
RAT TRAP —T. V. Clapp, 341 Main St., Springfield, Mass. The invention particularly relates to that form of rat traps which provide ready entrance to the trap, and which are so constructed that egress is made impossible, the *door construction aiding in* facilitating the entrance of an animal and effectively preventing its escape A further object is to provide a trap which is strong and inexpensive to manufacture

FISHING LINE —T. Bird, Decd., address Mrs. Hanna M. Bird, 29 Hubbard St., Cortland, N. Y. The invention pertains more particularly to lines of the water proof enamel type especially used for fly casting It is the primary object of this invention to construct a line which may be completely water proofed without liability to crease or break A further object is to provide a line of greater strength than the ordinary braided type.

WINDOW GLASS PROTECTOR. —F. S. Giles, 575 Riverside Drive, New York, N. Y. The invention particularly relates to a device for use in connection with glass windows for preventing excessive vibration thereof, tending to shatter the glass A further object is to provide a protector which may be readily applied in position and so constructed as to be readily adjusted to windows of different sizes, and to permit the cushioning member to contact with different parts of the window glass

TIME-CONTROLLED DAM GATE — E. Karns, Jackson, Wyoming. The invention relates to controlled mechanism regulating the release for the out flow of the dammed fluid at any desired time An object is to provide a simple mechanism particularly with respect to the means utilized to normally hold the dam gate closed, and capable of application to gates of various form.

MATTRESS HOLDER —Mariana T. Jones, 86 Rockview Ave., Jamaica Plain, Mass. An object of the invention is to provide means on a spring bed which will hold the mattress against slipping and which, when the mattress is removed can be folded out of the way so as to closely fit the spring bed A further object is to provide such device at the foot and head of the spring body which will hold the mattress and prevent slipping, particularly in cases where the footboard or headboard is lowered



A PERSPECTIVE VIEW SHOWING THE DEVICE IN POSITION

FUSE PLUG FOR GRENADES —F. L. LeBlanc, 48 Rue Lamartine, Paris, France. This invention is essentially characterised by two features A special arrangement of the mounting of the detonator which insures its perfect concentricity with reference to the fuse cord and permits a simple, easy and rapid adaptation of this detonator to the fuse plug, and the provision of an insulating sleeve mounted in the interior of the body of the grenade, and in which the fuse plug is placed and fixed

MOUTH CLEANING DEVICE. —J. L. Kelly, Aeolian Bldg., West 42nd St., New York, N. Y. An object of the invention is to provide a device which functions as a cleaning device for the teeth gums, tongue and other portions of the mouth and also functions as a massage device for the gums and is particularly adapted for use in the treatment of cases of pyorrhea.

Hardware and Tools

MASSAGE TOOL —H. Malm, 2107 5th Ave., New York, N. Y. The invention relates to a readily portable device for the treatment of the skin and flesh, it pertains more particularly to devices of this character operating upon the vacuum principle Among the objects is to provide a device for creating a vacuum in the presence of the skin or flesh of the human body in order to promote a healthy and vigorous condition thereof.

LOCK —J. E. Phillips, 260 Convent Ave., New York, N. Y. The object of this invention is to provide a construction which may be applied to any kind of a door, or device, at *the same time resist opening* and being tampered with, the lock including not only a bolt which may be projected and retracted, but a brace coacting with the bolt for resisting a jimmy or prying implement.

PUMP JACK —S. C. Christensen, Magdalena, N. M. The invention has for its object to provide a jack of the character specified especially adapted for converting rotary movement of a windmill, for instance, into reciprocating movement of a pump rod, with a minimum of side play. The wind wheel operated shaft is journaled in suitable bearings in a housing consisting *of an* upper and lower portion which are detachably connected.

SHADE AND CURTAIN HANGER —J. W. Jackson, Henrietta, Okla. An important object of the invention is to provide a curtain hanger or pole possessing a wide range of adjustment and at the same time a high degree of rigidity in any of its adjusted positions and which may be readily and easily assembled and mounted in position in connection with a window, door or other opening.

UNDERREAMER. —J. W. Pippin, c/o Pippin Mfg. Co., Oklahoma City, Okla. The invention has for its object to provide a device wherein the cutting bits are so mounted that they may be held in contracted position during the insertion of the reamer through the casing by latch mechanism, which is released when the bits have passed through the casing to permit them to expand.

SCRAPER —J. B. Kirk, 2 West Buckanan, Iola, Kan. The object of the invention is to provide a cylindrical scraper which will be very effective in cutting carbon and other deposits from inside of distilling pipes. Another object is to provide a scraper which will resiliently bear against the inside surface of the *pipes and will readily adjust itself to any* irregularities in the surface

COMBINATION FAUCET. —W. Meier, 1951 7th Ave., New York, N. Y. The invention more particularly relates to a faucet which may be used for mixing hot and cold water in various proportions One of the objects is to provide a single control combination fluid mixer of simple construction having relatively few parts and eliminating the necessity for the use of springs The faucet may be used with equal facility either as a sink, basin, shower or bath faucet.

PATTERN AND GUIDE STRIP —S. H. Calkins, Webster Ave. and East River, Long Island City, N. Y. The invention has for an object to provide a device which will permit the ready depositing and pushing of plastic wall or floor coatings of a number of different colors without the various colors commingling and also provide means for presenting a leveling or height controlling strip, which need not be removed after the work has been completed, and in addition will take care of the expansion of the material

Heating and Lighting

THERMOSTATIC VALVE. —R. N. Trane, c/o The Trane Co., La Crosse, Wis. This invention relates to thermostatic control for valves, its object is to provide a construction whereby the valve gate may be opened and closed easily and may be comparatively sensitive to changes in temperature. Another object is to provide a control which may be used on traps or other valves to open and close the same by a slight back and forth movement.

DRAFT REGULATOR. —C. W. Marden, Ridges Court, Portsmouth, N. H. An object of this invention is to provide automatic means for controlling the position of a damper in a smoke pipe in accordance with a draft. A further object is to provide a regulator which can be installed at a reasonable cost, and which will result in a saving of fuel, and maintain a fire at a predetermined rate of combustion, and will prevent overheating.

FURNACE WITH ROTARY GRATE —E. Romanet, 17 Rue de l'Elysee, Grenoble, France. This invention relates to boiler and other furnaces having rotary grates, the object being to provide a furnace of this kind the upkeep and attendance of which are easy while deterioration through clinkers is avoided, and regularity of draft through all parts of the grate is insured, as well as perfect combustion over the entire surface of the fuel.

Machines and Mechanical Devices

NUT BRANDING MACHINE. —T. S. Slick, 1842 Calvert St. N. W., Washington, D. C.

(Continued on page 398)

Motorizing the Rural Church

(*Continued from page 395*)

which made it possible for the farmer to attend churches many miles distant from his home with much less inconvenience than he had found in attending his little community church in former times. This change has brought about an increased social life, and has made possible flourishing community churches serving large populations Those churches lacking in the elements which make for a larger and better social life in the community are doomed to disappear, and there is certain to be no great mourning over their loss

The institutional church of today is demonstrating a capacity for work and service never dreamed of in the case of the old-fashioned rural church. It has adapted itself to the soil, and in many enlightened communities is serving as a community hall or center, where the social life of the neighboring country is developed along the most approved lines The suspicion of heresy which was once attached to the fortunate owner of an automobile who persisted in riding about the country instead of going to church has long since given way to the realization that the fault lay with the church which had failed to find its true mission

The important part the automobile has played in contributing to this change is explained by Statistician Baketell of the Methodist church in a report issued several years ago. "Almost every farmer in the Middle West," he says, "owns an automobile. When the family gets into a five- or seven-passenger car it finds it quite as easy to go five or ten miles to church as formerly to drive half a mile Doing so, a larger number meet together, there is more enthusiasm, better business, better preaching and a larger social life The effect is to shut the door of the white meeting house on the hill, just as it is, under similar conditions, to close the door of the red school house at the cross roads The effect of the automobile is just beginning to tell upon church and school house, and I expect to see further material decreases in the number of churches and school houses"

In the State of Iowa more than 1,200 rural churches have disappeared in the last twelve or thirteen years, and this number is constantly increasing Approximately 10,000 of the little white meeting houses have closed their doors in the Middle West farming belt in the last decade, and rural life experts and church leaders do not expect to see this movement halt until thousands of others have joined this constantly increasing number

The tendency of fifteen and twenty years ago was to overchurch the average rural community. The average rural community of 500 had from three to five churches within its borders and a scattering of small meeting houses in the surrounding country. It seems a miracle that any community, however prosperous, could have supported so many churches, so many of which had failed utterly to take root in the soil and apply themselves to the betterment of the social life of the country. This waste of resource and effort required to keep these churches going represented a most important drain upon the more active churches throughout the country, and there is no regret in this passing of the old order.

The old-fashioned church has given way to the community or federated church in which all denominations and interests may gather for religious worship and greater social progress The church has truly become an institution of service It has given root to what is known as the "corn" preacher, one who knows and loves the soil and who is able to meet the farmer on his own business level. He can talk corn and crops intelligently from the pulpit or in the field and can apply the lessons of the Bible in terms of farm life. This spirit is emphasized by the young country minister who declared: "If I cannot talk intelligently to the members of my congregation about the principles of good farming, I am not fit to serve them" This minister left his school to spend some months studying advanced farming in a nearby college, and he has succeeded in making his church one of the model rural houses of worship of the country.

Instead of moving to the city when their active days on the farm are over, the farmers are finding it more satisfactory to move up nearer the community church as a means of keeping up the social life developed under the new regime This has resulted in the founding of many small rural towns, and is pointed to by church leaders and rural life experts as one of the pleasing compensations for the loss of the old-fashioned church The young people who formerly motored to the nearby city for the Sunday services now park their cars before the community church, the old wagon sheds having been displaced in many instances by modern, sightly shelters for motor cars It is because of this tendency that the churches are not alarmed at the rapid rate in which the little white church of the past is disappearing.

Fuel Conservation Opinions—II

(*Continued from page 386*)

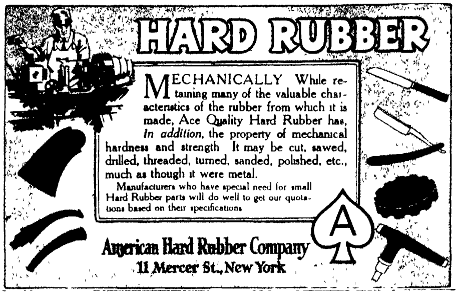
Should We Have the Super-Power Zone or Not?

One authority, the American Engineering Company, rather questions the value of grouping power plants into single large power groups There are of course, many sides to this question While economies can be effected by means of this grouping up to a certain point, this point is practically reached under present conditions in the large stations in such centers as New York, Philadelphia, etc, holds this authority The grouping would result in long transmission lines, and some real difficulties in distribution Power plant equipment, continues this authority becomes obsolete very rapidly New developments are so rapid that a present modern large power station does not represent the best performance when it is completed at the end of two or three years of construction In the so-called super-power stations this condition would not be improved There is, at the present time, undoubtedly a substantial element of competition between the largest and highest types of power stations that leads engineers to investigate and develop new types of apparatus which, to a very considerable extent, would be eliminated by grouping.

A similar opinion is expressed by Mr Frank S Frost, Superintendent of Power of the New Orleans Railway and Light Company He believes that with the demand for power, as it is in his section of the country, especially since the cities demanding a considerable quantity of power are widely separated, there is no call for so-called super power zones Mr Stuart Cooper, Manager of the Charleston Consolidated Railway and Lighting Company of Charleston, S C, concurs in this view, stating that the super power zone idea will be a proper procedure only as the concentration of population permits Thomas A Edison states that he "does not think our water powers have been utilized enough at present time to make grouping very attractive."

So all in all it would appear that the negative side of the super-power zone controversy is based on present, rather than future, conditions Several authorities tell us that the super-power zone idea will be evolved automatically as the need arises for such a measure Thus as the cost of power produced from bituminous coal in individual plants increases, due to the exhaustion of the more cheaply mined bituminous coal acreage, it probably will become more economical for the small power plants to discontinue making their own power and draw it from larger power groups, or so-called super-power

(*Continued on page 399*)



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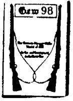

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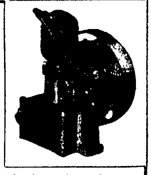

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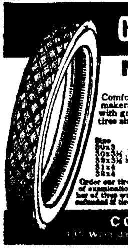

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RECENTLY PATENTED INVENTIONS

(*Continued from page 396*)

More particularly this invention relates to a machine for stamping and marking walnuts and other small articles, the main object being the provision of a device which will place a distinguishing mark upon articles readily and efficiently A further object is the provision of a device wherein the motive power is derived either wholly or in part from the article to be stamped, and from the impact of the article after it has fallen under the influence of gravity through a predetermined distance.

DESICCATING MACHINE.—G C Contant, 308 W 70th St, New York, N Y. The invention has for its object to provide a simple construction whereby liquid or semi-liquid may be desiccated, and wherein through the use of vacuum a minimum heat is necessary to produce the proper drying action A further object is to provide a machine in which a traveling belt is used with means for spreading the material thereover, the parts being so arranged that a large quantity may be desiccated in a minimum time

TOOTHPICK DISPENSING DEVICE—J. E Kenkel, Great Falls, Mont. An object of this invention is to provide a device which will present a single toothpick and which, when said toothpick is removed will be operated to permit another toothpick to fall into position for removal A further object is to provide a device which will dispense toothpicks from their original package, which will be entirely sanitary, and especially adapted for use in public places

EVAPORATOR — T M Pusey, Kennett Square, Pa The invention relates to evaporators and more particularly to an apparatus for evaporating water out of zinc-chlorid or out of alkali solutions or the like An object is to provide an inside partition or sleeve within a vacuum kettle, forming an annular chamber between the walls to cause the solution of zinc chlorid to circulate and prevent uneven or sudden forming in the main mass as well as to expedite the evaporation A further object is to utilize the heat of the water of condensation from the steam jacket surrounding the kettle to assist in producing a circulation of the solution being treated

CALCULATING MACHINE—J M Brandvein, 754 E 151st St, New York, N Y An object of the invention is to provide a small and compact portable device which can be conveniently and quickly operated to find an unknown factor when other factors are known A further object is to produce a simple construction which is not liable to get out of order and which can be operated by any one of average intelligence to ascertain quickly factors which heretofore have required considerable mathematics

ATTACHMENT FOR PUNCHING MACHINES—C S Nelson, Little River Road, Quebec, Canada The invention has for its object to provide an attachment for permitting openings to be punched in work at predetermined points without the necessity of laying off said openings with a templet or the like, wherein a carriage is provided having guided movement with respect to the punch, and having means for clamping the works to feed the same to the punch and properly position the work

AIR COMPRESSOR—C M Tursky, 270 Willis Ave, Bronx, N Y The invention relates to an air compressor embodying a revolving element and a double ended floating piston the invention resides in various novel features including the air ports, means for actuating the pistons, and the lubrication system, whereby the lubricant is circulated through the piston for cooling, and effectively distributed to the bearings

TAMPING ROLLER—M M Emerson, 408 Gatzian Bldg, Pearl St, Ellensburg Wash The object of the invention is to provide a tamping roller which will be effective to completely tamp and roll, the entire surface being acted upon and which is of simple and durable construction, reliable and efficient in operation, and easy and inexpensive to manufacture

GAGE—R. G Bloxsom, 403 S 7th St., Camden, N J Among the objects of the invention is to provide in a single gage means for recording both pressure and vacuum, to provide a gage with a stationary dial containing a scale indicating vacuum and having a movable pointer registering therewith, and also to provide a movable dial having a scale registering with the zero mark or pointer of the fixed dial to indicate pressure.

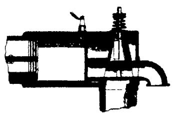
BINDING MACHINE—W. T. Weaver, Route 4, Highland, N. Y. This invention relates to the photographic industry and more particularly to that branch devoted to the manufacture of lantern slides for use in projecting machines. The object is to provide a machine for binding the sensitized negative and the cover glass by use of adhesive strips; a further object is to provide a machine which will correctly apply the adhesive tape in a perfectly regular manner around the edges of the two glasses thus forming a single unit.

Musical Devices

PIANO KEY REPAIR CLAMP.—E. R. Crandall, Coldwater, Mich Among the objects of this invention is to provide a clamp for holding the ivory veneer of the piano key while the glue is setting, the clamp being designed for and permitting the head piece and front piece to be clamped in position, at the same time, and without removing the key, and thereby saving much time and labor

Prime Movers and Their Accessories

ROTARY VALVE—H T Dutter, Albuquerque, N M This invention has reference to internal combustion engines and more particularly to a rotary valve structure for controlling and timing the inlet of the gaseous fuel charge or mixture to the cylinder of a motor and the discharge of the exhaust or burned gases therefrom, the construction being such as to require few parts, thus reducing the cost of production and maintenance and permitting operation indefinitely without regrinding or resetting valves.



SHOWING A SECTION OF GAS ENGINE EQUIPPED WITH THE DEVICE

IGNITION SYSTEM FOR INTERNAL COMBUSTION ENGINES—A P Riedelle, St Cloud, Minn The invention relates particularly to a device for indicating whether or not the several spark plugs of an engine are properly sparking The purpose is to provide an indicator which can be placed on the instrument board of an automobile, such device being capable of application to any standard ignition system without radical changes therein

ROTARY INTERNAL COMBUSTION ENGINE—H O Neebe, 601 W 100th St, New York, N Y This invention has for its object to provide a rotary internal combustion engine arranged to subject the rotor to a plurality of impulses at each revolution of the rotor, thus rendering the engine exceedingly powerful without requiring an undue increase in the dimensions of the engine

Railways and Their Accessories

RAILWAY SWITCH OPERATING DEVICE.—F G Smith, 366 Park St, New Bedford, Mass. An object of the invention is to provide switch-operating mechanism, parts of which are installed on the car, and parts in the track pit so the engineer driving a train may automatically throw the switch tongue for switching his train upon a side track, or directing the train forward on the main line without stopping the train

SMOKE CONSUMER FOR LOCOMOTIVES—B H Thomas, Clifton Forge, Va. The foremost object of the invention is to provide means applicable to the boiler shell of a locomotive in any convenient position, for admitting air in a volume which is capable of being adjusted for the purpose of supporting the combustion or aiding in the consumption of the discharged gases and unconsumed particles so as to practically eliminate smoke.

CAR MOVING DEVICE.—H. B, Weiss, Box 14, Binghamton, Tenn Among the objects of this invention is to provide a car moving device capable of being transported from place to place and carrying means for engaging a car and drawing the car toward the said device, and having means for anchoring the device to the track

VALVE—H Migues, New Iberia, La. An object of the invention is to provide mechanism in connection with the angle valves of air brake systems, for automatically setting the brakes behind the valve, when said valves are closed or partly closed, giving the engineer full control of the brakes above the said valve and for relieving the pressure in the air hose when the cars are cut off, both valves being closed, thus permitting the trainman to break the connection with ease.

INDICATOR MEANS FOR CAR SEATS.—N. J. Ryan, 51 Main St., Tuckahoe, N. Y. This invention has for its general object to provide an indicating means adapted to be secured to the back of a car seat or other suitable support, mechanism arranged to be controlled by the conductor, and to be set by him upon payment of a fare, in a manner that he may upon approaching the seat, inform himself at a glance respecting the destination to which an occupant of a seat may be entitled to be carried.

Pertaining to Recreation

AMUSEMENT DEVICE.—D. Bird, 266 W. 128th St, New York, N. Y Among the objects of the invention is to provide a game in which use is made of an inclosure having a pocket and in which a plurality of buoyant bodies are arranged and subjected to the action or air force impelled therethrough to seat and retain one of said bodies in the pocket, the arrangement being such as to obviate the necessity of manually removing the seated body from the pocket.

AMUSEMENT AND EXERCISE APPARATUS—J W E. Dean, 29 Cornelle Ave., Yonkers, N. Y The invention relates to an apparatus adapted for use either by a single person or by more, and in which may be employed a ball or balls and a receiver into which a ball may be thrown by the player and from which it will be automatically discharged in a direction to permit of its being caught by a player so that the ball may be returned to the receiver as rapidly as discharged.

AMUSEMENT DEVICE.—O. V Borgeson, 5017 6th Ave, Brooklyn, N Y. The principal object of the invention is to provide a device which is in the nature of a game requiring a certain amount of skill and in which the element of luck is only a secondary part. Another object is to provide a device simulating a race course over which a plurality of racing bodies are adapted to be moved between a "*starting point*" and a "*goal*," each of said bodies being under the direct control of one of the participants of the game.

INDOOR GOLF COURSE—G. Sochurek, 55 6th Ave, Astoria, L. I., N. Y The invention has for its object to provide an indoor practice tee, whereon driving may be practiced with the same energy and skill as if the player were operating outdoors. A further object is to provide a taut sheet which the driven ball strikes and wherein an indicator operates to indicate in proportion to the blow of the ball, and to register the distance of the respective drives

AMUSEMENT DEVICE—S W. Gash, Carr Apmt, Antralia, Wash This invention contemplates the construction of an amusement device, consisting of a sled or toboggan, fitted with wheels, and inclines which permit coasting at any time of year and in any climate. The device is designed to prevent accidents in coasting by protecting all movable parts with covering, so that no one can come in contact with the moving parts while in operation

ROLLER SKATE BRAKE—A. Ickenroth, R 1, Box 132, Clayton Mo. The invention has for its object to provide a brake of the character specified, by means of which the user may control the skates, to move slow or fast as may be desired, without interference with the free movement of the legs and arms of the user The device may be applied to any roller skate

Pertaining to Vehicles

TIRE RIM—E Acha, c/o Mr. Lake, 135 Front St., New York, N Y. The primary object of the invention is to provide a tire supporting rim which will greatly facilitate changing an incapacitated tire for a perfect one without the usual labor A further object is to so construct the rim that it may be manufactured relatively cheap, at the same time rendering it capable of carrying out its use with the greatest efficiency.

WINDOW—W S. Shields, R.F.D. No. 1, Yardley, Pa The invention has for its object to provide mechanism in connection with sliding window sashes, especially adapted for use with automobile buses, trolley cars, railroad coaches and the like, for making a close fitting joint between the sash and the window frame without the possibility of sticking, and which will compensate for wear.

INNER TUBE CARRIER.—J. M. Mills, c/o State Nursery and Seed Co., Helena, Mont. The object is to provide a carrier preferably made of sheet metal, including compartments and drums rotably mounted within the same, and pairs of rollers movable toward each other, and adapted to bear against opposite sides of the tubes upon their being coiled around the drum, with a view to avoid vibration and thus deterioration of the tube.

WHEEL TIRE.—O. Hopkins, c/o Ross Hopkins, Arguesville, N. Y. The particular purpose of the invention is to provide a device of the character specified possessing certain mechanical advantages, among them being resilience, reduction in liability to puncture, and the prevention of one part of the tire from shifting laterally in relation to another part. The device comprises an inner annular member and an outer annular member with springs, anti-friction balls, and other mechanism carried by the outer annular member.

TRANSMISSION.—O. S. Pulliam, Room 2525, Park Row Bldg., New York, N. Y. The invention pertains more particularly to a gear set especially adapted for transmission of power in motor vehicles. An object is to provide mechanism in which a direct connection is established between the driving and the driven members when it is desired to transmit the power at high speed, and in which the direct connection may be broken when it is desired to drive at low speed or in a reverse direction.

ALARM.—C. E. Muller, 568 W. 173rd St., New York, N. Y. The object of this invention is to construct an alarm particularly applicable for use in connection with automotive vehicles. Further objects are the construction of an alarm which shall be entirely accessible to the operator of the vehicle for the purpose of "setting" and "releasing," and which shall be extremely simple in its parts and economical in manufacture, and so constructed that it will be impossible to move the vehicle without operating the alarm signal, when the latter is set.

SPRING SHACKLE.—E. L. Ball, Alexandria, La. This invention has for its object to provide a shackle of the character specified, designed to prevent the usual noises attendant on the use of the usual type of shackle, wherein a specially designed roller-bearing is substituted for the usual bolt and bushing All end thrust is taken up by the rollers The outer race is adjustable without the necessity of dismantling the assembly.

VEHICLE TIRE AND RIM.—F. M. Henry, 201 Landis Ave., Vineland, N. J. The invention relates more particularly to motor vehicles. An object is to provide means for loosening the tire sections when it is desired to remove the same. A further object is to simplify the construction of tire sections without detracting from the advantages of the same or adding to the expense of manufacture.

Designs

DESIGN FOR AN ARTICLE OF MANUFACTURE—M Wilner, 44 White St., New York, N Y. This inventor has been granted two patents

DESIGN FOR A RING.—M. Simson, 125 Canal St., New York, N. Y The inventor has been granted two patents.

DESIGN FOR A GLOVE.—H. I. Seely, 450 Penn Ave., Waverly, N. Y.

DESIGN FOR AN ARTICLE OF MANUFACTURE COMPRISING A FLOUNCING OR EDGE FOR FABRICS—H. T. Mendelsohn, 40 W 25th St., New York, N. Y.

DESIGN FOR A DOLL.—Josephine M. Cook, Brookville Crest, Clinton Ave., Plainfield, N. J.

DESIGN FOR AN AUTOMOBILE WHEEL LOCK.—L. E. Trimm, 465 E. 29th St., Brooklyn, N. Y.

DESIGN FOR A BUTTON.—J. Fox, 49 W. 24th St., New York, N. Y.

DESIGN FOR A COSMETIC BOTTLE AND MASSAGE DEVICE—J. O. Linden, Box 668, Albuquerque, N. M.

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Fuel Conservation Opinions—II

(Continued from page 397)

zones Already power plants are being located at the mines, so as to eliminate the transportation of coal, and serving to distribute electric power to the erstwhile coal consumers over quite an area. Again, small power plants in thickly populated sections of the country are gradually becoming substations of larger plants Indeed, there are ample signs that the super-power zone idea is gaining ground, automatically and without attracting much attention, to be sure.

The Fuel and Power of Tomorrow

Speaking of new fuels and sources of power, it is interesting to learn that Californian power plants have recently been offered a new fuel—crude oil residue—produced by the oil companies from fuel oil by breaking the crude oil down into its constituents to a greater degree than has heretofore been the practice. The problem of suitable storing and firing methods for this new fuel is at the present time being studied The quantity of its supply is limited, since it will be a by-product from the distillation of crude oil.

Several large users of fuel are watching with interest the development of powdered fuel and colloidal fuel, which is now going on; but it is difficult to obtain a definite opinion as to the probable future of these fuels.

Lignite, even of the low grade North Dakota variety, will undoubtedly be more generally used in the near future, we are told by other authorities Heretofore stoking equipment had not been developed that would burn the lignite satisfactorily, but the advent of recent automatic stokers has provided a means to utilize this cheap, low grade fuel, and an increased use of lignite can be confidently expected.

Our attention is directed to the great possibilities of obtaining higher efficiency from the fuels now used and the saving of the by-products, as well as the expanding area of oil-producing sands and shale, also, there are possibilities for methyl alcohol and other fuel products Indeed, if we grasp the idea of certain authorities correctly, it would seem that we are only at the doorway of Nature's storehouse, and that we might well learn first to make the most out of our present fuels before we seek new varieties There is little doubt but that we shall be using powdered coal and gasified coal in ever-increasing quantities in the not distant future, after first extracting the valuable by-products, thus substantially reducing the cost of the fuel by obtaining certain by-products that are not permitted to go to waste But before much progress can be made along these lines, the problem as a whole should receive considerable publicity and no end of study

Edison suggests that the volcano and hot spring areas in the United States might give considerable power by means of deep bore holes and turbines. This scheme, it will be recalled, is in successful commercial use in Italy

But it is a fact that human nature never seeks a definite solution of a problem until the problem becomes acute There may be exceptions—Germany's development of her brown coals is an example, a very rare and worthy example, it goes without saying; but as a general thing the users of fuel are content in the assurance that of bituminous and anthracite coals, of petroleum and the lighter oils, of alcohol and of natural gas, and of all the other fuels which we are using today, there is an ample supply for many years to rome. Hence the prevalent implied attitude. Why worry?

Farming with Electricity

(Continued from page 387)

phase iron. The connected load is 250 kilowatts, which is carried by 200 kilowatts of distribution transformers The maximum use of energy occurred in April, 1920, when 10,920 kilowatt-hours were delivered from the substation to the company's feeders with a recorded maximum demand for 35 2 kilowatts.

The housewife shares generously of the benefits accruing from the application of electrical labor-saving devices on these Idaho farms Many homes have been constructed without chimneys, electricity serving the purposes of illumination and heating, as well as the operation of the washing machine, sewing machine, and cooking appliances Even the offspring of Mother Hen is warmed by current generated from the power plant, a carbon-filament lamp being installed in the chicken coop Electrically-driven pumps supply water to the homes, and the farmer hooks a motor to a jack shaft, which drives the pump, cream separator, grindstone, feed grinder, and other useful machinery The electric iron enjoys almost universal popularity, there being 1,862 flatirons in use The washing machine is operated by electricity in 875 of the homes of the rural consumers Vacuum cleaners, curling irons, ranges, moving picture machines, coffee urns, percolators, fans, water heaters, adding machines, vibrators, bake ovens, sterilizers, air warmers, and heater pads are among the electrical appliances in use Seventy per cent of the residents on this Government project being owners of sheep, electricity for pumping water to the stock minimizes labor requirements All told, 5,141 electrical appliances are in use, their popularity being represented by a 54 per cent increase within twelve months

When Oysters Are in Season

(Continued from page 388)

from New York and New England to foreign countries involves the use of barrels containing three bushels and one half peck, the container having a head Hotels and restaurants serve oysters on the half shell, the "Blue Points' from beds of a cape on the south side of Long Island enjoying a distinction when thus placed on the menu Likewise oysters are shipped in the shell from eastern waters to the Pacific coast for propagation purposes

Shucking is described as the process of divorcing the meaty contents from the shells, tables or stalls in oyster houses being assigned for the separation proceedings The water products are conveyed to the tables by wheelbarrows, in small establishments In more pretentious oyster houses the oysters are first taken to a storage room and let down through chutes to the individual stalls of shuckers The operator stands on a bench before the table, upon which the shell fish tumble from the descending movement through slanting chutes Blocks are accessible for placing the oyster for opening Skill and muscle power are requisites for shucking A mitten is worn on the left hand to avoid contact with the knifed edges of the shell, the hand of the shucker moving with incredible speed A knife is used in prying the shell apart From ten to twelve gallons constitute a reasonable day's work The meaty contents are deposited in a galvanized-iron container, while the shells gain admittance to a trough in the shucking table whence they are transported for concentration by a mechanical carrier. The meat of the fish may be then robbed of its excess fluid by perforation. In small oyster houses the shells are deposited on the floor alongside the shucker and later removed in wheelbarrows A movable wooden stall, 18 or 20 inches wide, quarters the operator and protects him from the accumulating mountain of shells During the season of 1919-1920, shuckers were paid from thirty-five to forty cents a gallon.

Once deprived of their shell enclosed home, the meat of the oyster is placed on washing tables Simple in construction, these units are made of galvanized iron, measuring 5 feet long and 2½ feet wide, and supported on a wooden framework Water drainage is effected through a per-

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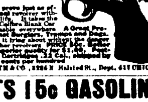

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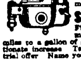

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forated bottom A series of washings is administered, fresh water usually being applied The legislation of some states, however, makes it obligatory that salt water of a specified strength be used as an agency in forestalling bloating by the absorption of fresh water Oyster houses having necessary facilities administer a preliminary washing on tables and then convey the oysters by a lazy-flowing stream of water down runways to tanks on a lower floor Here, two washings are given them, not unlikely compressed air being blown from pipes through the water containing the products of the Chesapeake Bay

Oyster canning as an industry has developed rapidly within recent years, 15 canneries being in operation in Baltimore Georgia, Mississippi, South Carolina, North Carolina, Louisiana and Florida, maintain 18, 16, 12, 7, 7, and 5 canneries, respectively Not unlike raw oyster houses, canneries have wharf frontages where the products of the waters may be conveniently unloaded Huge tubs or buckets are the receiving containers, these being dumped immediately into cars 10 or 12 feet long, made of iron strips, fashioned like baskets The cars are moved on a track into the cannery, some of these diminutive trains carrying 15 cars with 20 bushels of oysters to the car The cars terminate at a junction of rectangular iron steamers, which accommodate three units simultaneously Steam is passed through them for three to ten minutes The train load is moved to the other end of the steamer, where the oysters are opened directly from the cars by shuckers A metal bucket, suspended by a hook from the side of the car, is the container for each shucker These buckets are perforated, admitting seepage of excess liquor A knife is used in separating the shells from the meat, an easy task after the steam has been applied When a bucket has been filled, the oysters are weighed, the shucker receiving payment according to weight From the weighing scales, the shelled products are washed two or three times in vats or on tables, whence they are conveyed to a packing table Structurally, this table is of wood and is 12 feet long and 6 feet wide at its widest area and 3 feet wide at its narrow portion Women and girls do the packing, empty cans being available from boxes located near by The cans have a capacity of three to ten ounces. A belt carries them along a trough under a leaking pipe from which hot brine is deposited in the cans The same belt forms connection with the capping machine, the latter crimping covers at a rate of 58 cans to the minute Having tacitly said goodbye to the capping machine, the cans are cornered in roomy circular iron baskets, four feet across, and lowered into a cylindrical metal processing tank The cans are subjected to steam at high temperature, shortly being removed and lowered into a circular wooden tank or cooler Running water is the cooling agent. Baskets of cans are wheeled on tracks to the labeling and packing room, where labels are pasted, and forthwith the finished product is packed in boxes

Crushed shells are relished by chickens, the product first being dried in a direct-heat rotary drier The percentage of moisture in the shell is the determining factor as to the degree of heat to be applied—the greater the moisture content the higher the temperature. The regulation of the latter is all-important, as the shells may be deprived of their virtue by excessive heat A crusher is used for pulverizing the material, a revolving screen separating the crumbled material with respect to various grades. Oyster shells, as road-building material, may be partially crushed or placed on the highways in their entirety, letting the abrasive action of traffic do the work The excessive acid in farming lands may be relieved by lime produced from shells. They are burned in a kiln, the interior of which is cone-shaped at the bottom. An elevator deposits the shells in the kiln, a bit of fine coal being mixed in as fuel The fire burns constantly, and the burned material is shaken through the grate at the bottom The product is permitted to air slake, the lime being sold for $8 a ton.

A Stride Forward in Electric Welding

(Continued from page 389)

so good, but now for the really distinctive features of the process—the agencies provided to get rid of impurities and to promote deoxidization while shielding the incandescent deposited metal from contact with the air. The welding wire, no matter what its composition, is immediately surrounded by a jacket of aluminum, and outside of this is an envelope of blue asbestos In the flame of the arc, the aluminum commingles with the material of the melting rod and cleanses it before that metal is condensed and deposited at the point desired, and at the same time the fused asbestos forms a cloaking slag which remains atop the accumulating metal This asbestos layer holds the atmosphere at bay on one side and checks the escape from beneath it of the momentarily vaporized carbon, silicon, manganese, etc, which may characterize the steel's make-up These several actions go on automatically, and the welder has only to guide the electrode and to bring the operating current into service at will. The asbestos slag is easily got rid of when the weld has chilled because the stuff is brittle and readily detached by a hammer blow

It seems that the quasi-arc weld requires less deposited metal to produce a satisfactory junction—a little more than half that found in the run of welds; and the losses of the electrode metal during welding are upon a similar scale The value of the quasi arc weld under impact and alternating stresses is equal to more than 75 per cent of the strength of the plate joined by it. Other arc welds have a relative value, compared with the original plate, of upward of 30 per cent Finally, the quasi-arc weld can be made 50 per cent more quickly and is no more expensive than competing arc-welding systems

Fixed Stars That Are Not Fixed

(Continued from page 390)

Harvard procedure of superposition. And not only does it differ from the Harvard method but also from that used by Prof J C Kapteyn in the measurement of parallaxes Professor Kapteyn photographed upon one and the same plate the same field at intervals of a half or a quarter year He then measured the intervals between images of the same points of light Naturally, the bulk of the points showed no displacement—only those which had really moved The stereocomparator has the advantage of *attracting* attention; only, as we have seen, it attracts the eye to too many objects The application of the microscope to the pair of plates seen as one in apparent association with motion gives effective results in advance of those got by any of the methods of superposition and in advance of the simple stereocomparator.

The blink microscope views only one of the fields at any given instant, but the arrangements are such that there is a rapid alternation from one field to the other, back again and so on. Here is where the "blink" comes in The shutter is so arranged that it may be rapidly operated to cut off the light from one field and simultaneously pass it from the other and to make now this, now that, the field actually before the eye. When this instrument has mounted two records of the same field that are absolutely identical, the rapid operation of the blinking device serves to produce simply the effect of seeing one record in a fixed position. The flitting from one to the other is not discerned. The same principle of physiology is invoked here as in the moving picture projection camera. An image impressed upon the eye lingers an instant If the image is withdrawn, without visible movement, and then presented again, also without visible movement, the eye is none the wiser, provided the interval between presentations is sufficiently small. The old stimulation of the optic nerve persists and during its persistence a new stimulation is effected In the blink apparatus, while the two photographic records are actually separated, this is not the effect on the eye. It sees both along precisely the same line of vision. Light passes from but one record at a time The shutting off the light and the permitting it to pass fail to inform the eye that a shift of object has been made. Now, if, in the microscopic fields, which are naturally much smaller than the fields of the photographic records, one stellar image differs minutely from another, both being of the same object, the rapid alternation from one field to the other will produce a quiver, if the displacement be small, and a jump if it be large. "Small" and "large" here mean relatively to the small fields. The microscope may be shifted so as to have its field pass over that of the photographic record. In this way the whole of the latter may be examined. Of course, the displacement may, as already intimated, be too small for the power of the microscope The usable power of a microscope depends largely upon the amount of light thrown upon or passing through the object under examination

The principle of operation of the blink microscope may be understood better, perhaps, with the aid of a diagram. In the figure, P_1 and P_2 are the photographic records taken at different times. Light from P_1 is totally reflected from S_1, passes through the microscope objective Q_1, and is reflected totally again at S_1 Similarly, light from P_2 is totally reflected at S_2 and passes through the microscope objective Q_2. There are two glass prisms, p_1 and p_2, united along the surface s_2, a half-transparent silver film. The light from P_1 is *passed* through with the same intensity that the light from P_2 is *reflected*. There is no especial difficulty, it appears, in providing for identical intensities. Whether the light comes from P_1 or P_2, it passes through the microscopic field determined by the opening B and on into the ocular O.

Re-Covering the Cables of the Williamsburg Bridge

(Continued from page 391)

from the cables, the latter are opened up by driving half a dozen wooden wedges, placed evenly around the periphery of the cable, until they reach well into its center The cable is then thoroughly saturated with linseed oil. The next step is to compress the mass of wires into circular form by means of a powerful circular-hinged clamp provided with a hydraulic jack, the total pressure exerted by the clamp being about thirty tons. This done, the workmen place around the cable, close up against the clamp, a ¼- by 4-inch band which is bolted in place. As soon as the band has been bolted up, the hydraulic jack is released and again applied at a point a few feet distant. These bands remain in place until the wire winding reaches them, when they are successively removed. As the winding progresses, the wrapping wire is painted—four coats being applied—successively. This completes the job. If the cables are periodically painted, there is no reason why they should not be as enduring as the pyramids. It should be mentioned that the movement of the winding machine along the cable is due to the pressure of the new wire as it is forced into place against the wire which is already in place. The work is being done under the supervision of S. Hamburger, C. E., to whom we are indebted for courtesies during the preparation of this article.

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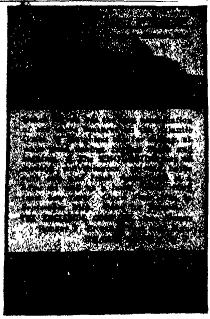

IN THIS ISSUE:

PUTTING WASTE METALS TO WORK
THE GIANT OF THE SKIES

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

30. JUN. 1921

GETTING A COAL CAR UP AN INCLINE WITH THE ELECTRIC "BILLY GOAT".—[See page 413]

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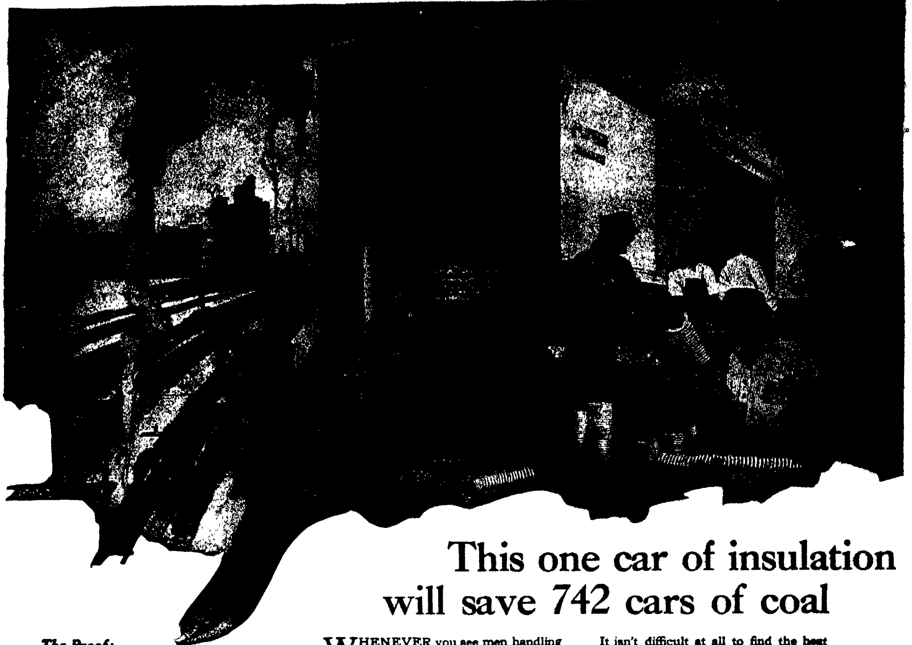

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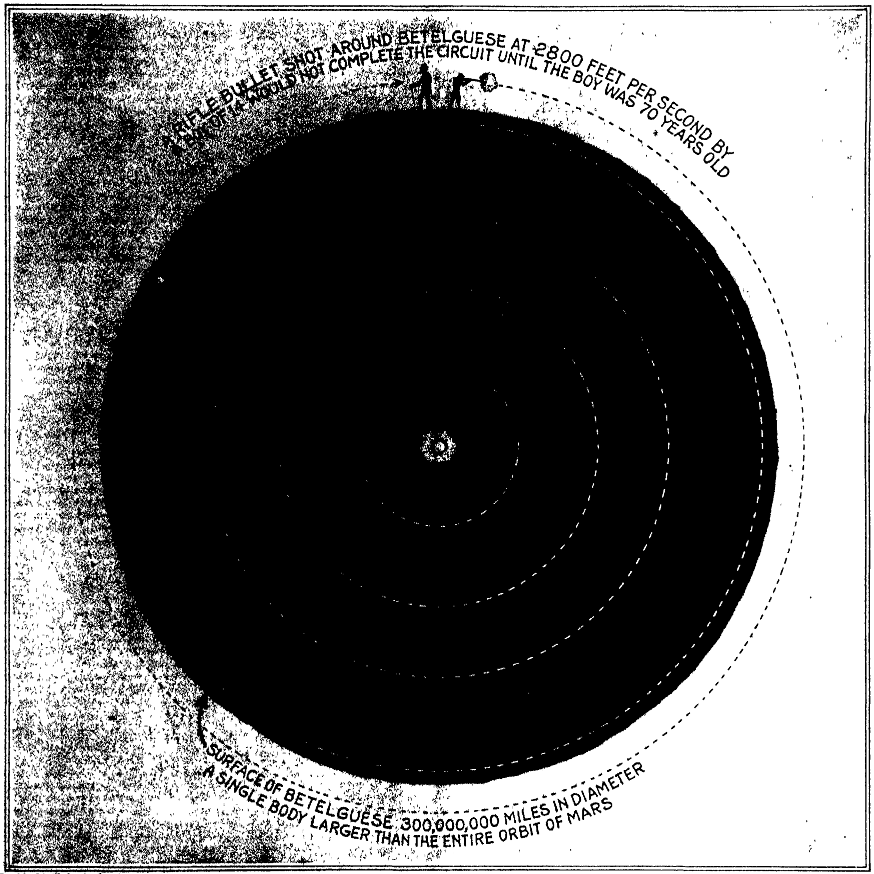
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SURFACE OF BETELGUESE 300,000,000 MILES IN DIAMETER
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A GRAPHIC REPRESENTATION OF THE TREMENDOUS SIZE OF BETELGUESE, A HUGE SUN LIKE OUR OWN, BUT ALL OF 300 MILLION MILES IN DIAMETER—[See page 409]

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Co-Ordinating Our Waterways

IT cannot be denied that Nature has been lavish in the provision of navigable waterways on the Northern Continent , it is equally certain that no proportionate advantage has been taken of these facilities, not at least during the era of the steam railroad and the motor truck Prior to the age of railways *the people of this country were driven to the use of our* navigable rivers and inland waters by the sheer force of necessity. Travel by steamboat was faster and cheaper than travel by the slow stagecoach and the lumbering freight wagon To a limited extent the national waterways were linked up by canals of small size and some of these, in spite of their shallow depth, demonstrated their capacity for the opening up of sparsely settled and undeveloped country to such a *marked* degree, *that* it is indeed surprising that our canals should have become stagnant and ultimately passed into the limbo of discarded utilities

The most ambitious and successful among these early canal systems was that undertaking, stupendous for its time, of linking the Great Lakes to the Atlantic Ocean by means of the Erie Canal, or "Clinton's Ditch," as *it was doubted by the doubters of that early day* De Witt Clinton, however, had imagination vision and courage, though in 1825 when, as part of the ceremonies attending the opening of the canal, he sailed down New York Bay to Sandy Hook and emptied a vessel of fresh water brought from Lake Erie into the salt brine of the Atlantic, it is likely that even he with all his faith, little dreamed of the enormous advantages which the completed canal was going to confer, not *only* upon the Port *of* New York but upon the whole territory traversed by the Canal

Then came the railroads with their more speedy and cheaper system of transportation, and gradually and inevitably the Canal suffered from neglect Our forefathers of that day apparently failed to grasp the lesson which had been taught by the Erie Canal , otherwise *they would have steadily improved and enlarged* their systems, realizing as the engineers on the continent of Europe have done, that a network of canals is the natural complement to a system of railways

Today we have in the rebuilt and enlarged State Barge Canal a system which is capable of moving twenty million tons of freight during the navigation season It forms a natural outlet for a considerable share of the great amount of freight traffic from the Middlewestern States, which is carried by rail to the ports of the Great Lakes and by water to the western terminals at Buffalo Of grain alone, from 50 million to 100 million bushels are received in Buffalo each year for export shipment, and of that amount, six million bushels only were moved through the Barge Canal in any one year of its prosperity

Much has to be done before the Canal can fulfil its purpose as a link between lake and ocean traffic The present is the psychological moment for developing waterway traffic to its fullest capacity for the high cost of transportation by the railroads and the heavy congestion are factors which should prove to be very helpful in diverting its legitimate share of freight transportation to the Canal A movement is now afoot under the auspices of the Middlewest Great Lakes, *Hudson River and Atlantic Association to develop the* necessary terminal facilities at Great Lake and Atlantic ports, and to secure the coöperation of the operators of ocean-going vessels with inland waterway interests represented by the State Barge Canal and the Great Lakes shipping interests, so as to stimulate a through bill of lading movement If this can be brought about, a manufacturer located on the Great Lakes, on the State Barge Canal, or indeed, on any inland waterway, will be able to ship his goods by means of an all-water route with a through bill of lading to a foreign port. This is a most practical movement, which should command the support not merely of the shipping and canal interests themselves, but of every commercial body throughout the territory that is served

The "Mystery Towers" Explained

WITH the passage of time the greater secrets of the war are gradually being disclosed, a case in point being those enormous concrete structures which were built *on the* English side of the Channel for a purpose which was most carefully concealed as long as the war lasted, and indeed, was known to a very few for a long period after the Armistice A description of the launching of one of these was given in the SCIENTIFIC AMERICAN of October 16, 1920 It will be remembered that the towers were built on the foreshore and were launched in the regulation fashion at high tide They were circular in plan, with a maximum diameter at the base of about 200 feet, and they were some 250 feet in height The whole thing constituted a huge, hollow, monolithic mass of great weight and strength

Speculation naturally was rife as to their purpose, and in this respect they shared attention with the so-called "Hush Hush" ships themselves Generally and *popularly they were supposed to be intended as forts* which were to be floated to position and sunk until they rested upon the sea bottom, leaving a sufficient portion of the upper structure exposed to serve for the mounting of heavy ordnance Now, however, it appears that these two were only a pair out of some score of similar towers which were to be built, and that their purpose was to assist in absolutely closing the English Channel at Dover against the passage of submarines They were to be floated out and sunk at intervals of a mile, and serve as anchorages for very heavy chain nets which were to be stretched from tower to tower Their heights would have varied according to the depth of the water, and the tops of the towers being clear of the waves, were to be used as emplacements for batteries of guns

Things were *done on a big scale during the war* and certainly this scheme for absolutely shutting up the Channel was one of the most ambitious It would have cost a pretty penny by the time it was completed , but considering the great strategical advantage of forcing submarines to pass out and return to the North Sea around the north coast of Scotland, the venture would *have been well worth its great cost*

Our Railway Mileage Is Shrinking

IF anyone had dared to predict in 1912 or at any time in the preceding seventy-five years, when our railroads were weaving their net over the land, that a day would come when that development would cease and a positive shrinkage in the totals would appear, he would have been laughed out of court Yet, once more it is the unexpected that has happened, and statistics compiled by the *Railway Age* show us that railway *construction* has been reduced *practically to* nothing and that the very slight addition of 314 miles in 1920 has been more than wiped out by the fact that 713 miles of line were abandoned and that on 240 miles of this the track was actually taken up This gives a net loss in 1920 on the whole railway system of about 400 miles. Going back to twenty-five years ago, we find that in 1895 there was built 1,420 miles of new line, and that the yearly record rose until it reached 6,026 miles in 1902, an increase which probably will never be surpassed in the future From 1902 there was a decline until the annual total reached about 3,000 miles, which continued for the years 1911 to 1913 The influence of the war was quickly manifest in slowing down new construction, and in 1914 there was a drop to 1,532 miles of new line, and in 1915 to 932 miles, with a rise to 1,098 in 1916 *From that time there was a steady* decline to 686 miles in 1919

Because of the fact that the existing railroad system is badly in need of reconstruction—some of our ablest experts have stated that it will take five billion dollars to bring the roads up to perfect condition—it will probably be several years before any marked activity in the building of new roads takes place. On the other hand, it is certain that when conditions have come back to normal, there will be ushered in gradually a new era of road building to meet the inevitable expansion in population and industry. This construction will be confined to developing the existing roads by the building of interconnecting lines and feeders to the trunk lines

Words of Wisdom on the Shipping Problem

THERE is probably no subject, unless it be that of Reparations, upon which so much has been said and written and such diverse solutions offered as in respect to the problem of our Shipping Board policy. To our thinking, the best summing up of the situation is that which was made by James A Farrell at the recent National Foreign Trade Council Convention in Cleveland, Ohio

Looking at the matter broadly, Mr. Farrell laid his finger at once on one root of the trouble when he said that the present conditions are the outcome of haphazard efforts to deal with a problem which from the very first called for a settled policy and a well-defined purpose To begin with, for a period extending from the Armistice well into the year 1919, there was an opportunity to dispose of a large portion of the fleet at prices bearing a fair relation to a moderately depreciated cost That was the time, our readers will remember, when a *bona fide* offer was made to purchase the "Leviathan," a deal which would have gone through except for the spiteful opposition of the Hearst papers and certain other influences of a strongly anti-European flavor Through not taking advantage of this opportunity, the Government, says Mr Farrell, "missed its market," and, it is estimated, lost a chance to realize at least 800 million dollars, this sum representing the difference in the market value of the tonnage which could have been sold at that time and the value of the same ships today The Shipping Board fleet cost *over three billion dollars, and the question of getting* rid of these ships by sale is hampered by our perfectly impossible navigation laws We are told, moreover, that even a temporary improvement in ocean freights would fail to absorb the world's idle tonnage in less than three years Approximately seven million tons of the world's carrying capacity is laid up out of a total of 60 million tons, of which five million tons is not yet completed

In Mr Farrell's opinion we have to recognize that the policy of the Shipping Board of endeavoring to build up trade routes from every Atlantic, Gulf and Pacific port to practically every port in the world is expensive, and, under present conditions impracticable He believes that a partial solution of Shipping Board difficulties would be to lay up a considerable portion of its *tonnage and withdraw from all but supervisory* activity by chartering the steamers to reputable and experienced operators. With this policy we have always been in hearty agreement The operation of shipping, with all its multiplied and varied activities and problems, is one of the most highly specialized branches of commerce and industry It should be left to the genius of the men who have had long experience The Shipping Board scheme of laying out trade routes and supporting the unprofitable lines by *active and very* generous financial help is attractive on paper, but, as the event has proved impossible of fulfilment, at least under the present disturbed world conditions

But after all is said and done, Mr Farrell lays his hand upon the most serious handicap of all when he says that the main factor in determining whether we can compete successfully with foreign tonnage is our shipping laws From the very day on which the La Follette bill was passed the SCIENTIFIC AMERICAN has realized that this bill would be the undoing of our Merchant Marine; and everything that has happened since then has proved the fear to be well founded Not only do our navigation laws strangle our ocean-going ships, but they are affecting even the carriers on the Great Lakes, where we have no local foreign competition. As compared with competing foreign ships on the high seas, American vessels must maintain larger crews, 65 per cent of whom must be licensed men and they must carry in the engine room crew 30 per cent more men The solution of the shipping problem lies in chartering the boats to competent people of long experience in the shipping business, coupled with a drastic revision of our navigation laws.

Automobile

Water Pressure Damages Body.—When washing the car, don't turn the hose directly on the wheels or body unless the water pressure is very low. Pressure usually built up by the nozzle is sufficient to mar the paint or dislodge it where the water is foolishly dashed against the surface. The best way is to use a pail of water and a sponge. Then much gentler treatment of the paint will result. After this mud is loosened with the sponge and water, it may be flushed off with the water from the hose, which is used without the nozzle.

The Engine as a Brake.—Some motorists appear to have the mistaken notion that it is harmful to the engine to use the compression as a brake in going down steep hills. Shut off the engine and leave the gears in mesh, so that the wheels drive the engine against the compression in the cylinders. Be sure that the throttle is closed. This will help to save the service and emergency brakes from excessive wear. If greater braking power than that afforded by the high speed position of the gears is needed, shift into second or low, the braking effect being increased as you step down because the rear wheels drive the engine faster.

Palm Oil as Fuel.—A series of experiments, begun in 1914, but interrupted by the war, has recently been resumed in Brussels on the use of palm oil in internal-combustion motors. A Swedish two-cycle semi Diesel engine was found which would run successfully on palm oil. According to analysis by Belgian chemists, palm oil is a mixture of palmitate and oleate of glycerine, with some variable quantities of palmitic and oleic acid. It contains about 95 per cent of fatty acids and appears as a pasty substance of yellowish or salmon color. Its caloric power is estimated at 9,228 calories (Barthelot-Mahler), and it is inflammable at 210 degrees centigrade.

Average Life of Automobile.—As highway transportation develops and passenger cars and trucks become practically the sole means of road travel the proportion of first purchasers of cars and trucks in the total of car sales will decrease, and the demand for new cars each year will become more and more nearly equal to the number of cars which drop out of service. For this reason it is becoming increasingly important for the trade to know how many cars will be required for replacement of those withdrawn from service. Analysis of registration, production, export and import figures over a period of years leads to the conclusion that the average life of the 2,000,000 cars retired from service in the last 7 years was about 5.3 years.

Use of Aluminum in Auto Manufacture.—An average of 120 pounds of aluminum is used in the manufacture of all automobiles—Fords excluded—according to a brief filed by the National Automobile Chamber of Commerce with the Ways and Means Committee of the House of Representatives. This figure was obtained from the principal aluminum producer, and it refers to the allotment of the crude aluminum set apart for the automotive industry by this company. In some cars the weight of aluminum used is as high as 250 pounds. The automotive use of aluminum is estimated at 120,000,000 pounds, 60 per cent of the production. The brief was filed as supporting the request that the present duty on aluminum of two cents a pound should not be increased. One of the present obstacles to the use of aluminum in our industry is the price and if the tariff is removed the demand for the metal would increase.

Tractors Have Winch Attachment.—Caterpillar type tractors are extensively used in the logging industry as well as in the oil fields. The winch attachment recently developed facilitates skidding logs out of relatively inaccessible places, and is useful in pulling and running back tubing and rods used in oil wells. The winch is operated independently of the driving mechanism of the tractor. The drive is from the rear of the transmission-case by propeller-shaft and gear-train to internal gear planetary and final bevel gears. A clutch of ample size to permit slipping indefinitely is provided. The standard pulling speed of the 5-ton winch is 108 and 252 feet per minute on low and high gear respectively, and the corresponding pulls are 10,400 and 4,450 pounds. Maximum reverse speed is 583 feet on low and 1,360 feet on high gear. Other speeds are obtained by slipping the clutch. Two other sets of gear ratios are provided at option. The winding drum is 8 inches in diameter and 13 inches between flanges, and has a capacity of 1,300 feet of ½ inch, 850 feet of ⅝ inch, or 590 feet of ¾ inch cable. All shafts and gears are nickel or carbon steel, the gears being case hardened. Ball or roller bearings are used throughout and the gears and moving parts are enclosed.

Science

Compressed Wheat.—An odd suggestion comes from England as to conserving wheat. It is proposed to crush or rough grind wheat, then soften with super-heated steam and compress in hard blocks and store until wanted, when a simple crushing process would fit it for flour manufacture.

A New German Clock that records all kinds of things besides time aroused the interest of Consul Breed at Prague to such an extent that he wrote the Commerce Department all about it. He saw it at a fair and said it would tell the second of the minute, minute of the hour, hour of the day, day of the week, week of the month, month of the year, season of the year, position of the stars and the exact position of the earth in its orbit, all for the trifling cost of 5,000 Austrian crowns, or about $50 in real money.

Lead-Lined Gloves Minimize the Danger of Radium.—Experienced scientists who experiment with radium are using lead lined gloves, but younger operators are apt to neglect such safety devices. Wooden tables should also be provided with lead linings to save the legs of the experimenters. The rest of the body can be protected by thin metallic sheets. The dangers with radium are so great that the French Academy of Medicine has granted a special subvention looking toward the amelioration of the dangerous conditions.

The American Museum of Natural History is in need of money. President Osborn in his last annual report calls attention to the necessity of nine new additions to cost $10,000,000. It is now fifteen years since the last building addition was made and since that time the collections have grown enormously. The following are the nine new buildings proposed: Asiatic Hall, Oceanic Hall, School Service Building, Roosevelt African Hall, Roosevelt Memorial Hall, Astronomic Hall, Aztec Hall, South American Hall and an auditorium and lecture hall seating 3,000.

Woman Mummy Found in Denmark.—The mummified body of a woman who died 3,000 years ago was found recently buried in a field in the Jutland district of Denmark and is being unwrapped by employees of the National Museum. Her coffin was the hollow trunk of an oak tree and the body was wrapped in a cowhide, says a cablegram to the *New York Herald*. She appears to have been a person of rank. Her garments included a short jacket with sleeves and a petticoat and she wore two belts around her waist and two bronze bracelets on her arms.

The Curie Family Continues to Make Discoveries.—The luster of the Curie family continues undimmed. Mme Curie has succeeded in determining the respective proportions of radium and mesothorium, which has hitherto baffled the savants who have considered mesothorium as more powerful. Professor Laporte, a cousin of Mme Curie, has discovered a new method for measuring the speed of gaseous emanations. Mlle Curie, a niece of Mme Curie, after months of study, has succeeded in determining the atomic weight of some substance the name of which is garbled in cable transmission.

Again the Half Nickel.—A two and one-half cent coin is not a new proposition. It was proposed during the war to help reduce the cost of living. Another minor coin is not considered desirable by all. Some persons are afraid that 5 cents would go up to 5½ cents if a convenient coin were provided, but many commodities would undoubtedly be decreased thus "two for a quarter" could safely be 12½ cents for one. Daily papers which are now three cents would in many cases be reduced to 2½ cents. One of the tangible objections would be the fact that cash registers cannot cope with the extra half cent at present. The idea of the coin's bearing a likeness of Theodore Roosevelt is a good one. Zinc has been urged as a metal for the new piece.

Treasure Trove in the Goodwin Sands.—The idea of searching the Goodwin Sands for treasure is not quite a novelty. Several proposals have been made before to recover the millions mentioned by Lord Headley in his presidential speech to the Society of Engineers. The chief and most promising of them came from two men—a civil engineer named Bush and J. D. Paln, an architect. They proposed to construct a harbor of refuge out of Trinity Bay, and from it to tunnel the sands, says the *English Mechanic*. The work was to take many years. The idea caught on, money was promised, but more practical men pronounced against it. Another suggestion was to run out a master tunnel from Deal and from it to have short tunnels branch off. A third scheme was that of a Midland mining engineer, who became so obsessed with his idea that at last he went mad and drowned himself on the very sands he proposed to explore.

Industrial Efficiency

Permanent Vienna Fair.—Plans are well advanced for the establishment in September, 1921, of a permanent industrial fair in Vienna. A company has been organized for the purpose. It is proposed to exhibit at the permanent fair manufactured goods of all kinds and from every country. It is hoped that this exhibition will furnish an opportunity for buyers from the eastern countries and the Balkans to meet representatives of western manufacturers and to inspect their products, thus facilitating trade between the east and west through the old established channels in Vienna.

A New Source of Tannin, it is learned from Consul Starrett, has been obtained by a resident of Adelaide, Australia, who has secured from the Government of the Fiji Islands the rights of all the Donga timber in that colony, and a small company is now being formed. This is undoubtedly a most important development, as the Donga tree carries a thick bark which contains a very high percentage of tannin. The wood is also exceedingly hard and durable. The percentage of non tannin in the liquid produced from the bark is so small that it easily outrivals the Australian and South African wattle bark, which hitherto has always held the leading position as a source of tannin extract.

Britain's Efforts to Increase Foreign Trade.—It is reported that the Department of Overseas Trade is "*steadily extending its trade-commission service in all* of the principal markets, and is keeping traders well advised of German methods and of trade openings available for British exporters." Large numbers of merchants and traders will visit the Leipzig fair. British wholesale prices are being drastically cut and the fact is made widely known by a new scheme of mass advertising in all the world's leading newspapers, in Australia, France, Japan, India, South America, South Africa, Belgium, Holland, Cuba, Scandinavia, and so on. In some cases the advertisements will run parallel with German manufacturers announcements so that a comparison of prices and of quality can be studied by foreign buyers.

Unemployment Insurance.—The British unemployment insurance act of 1921, which became effective on March 3rd, increases the weekly rate of unemployment benefit to 20s per week for men and 16s per week for women, with half rates for boys and girls. From July 4th, 1921, *increased weekly contributions will become* payable, viz., 11d for men (6d from the employer and 5d from the worker), and 9d for the women (5d from the employer and 4d from the worker), and corresponding half rates for boys and girls. During each of the periods, March 3rd, 1921 to November 2nd, 1921, and November 3rd, 1921, to July 3rd, 1922, a maximum of 26 weeks' benefit may be drawn in each insurance year. It is interesting to note that any applicant losing his employment through misconduct, or owing to a trade dispute, or leaving it voluntarily without just cause, will be disqualified for benefit.

Pilferage in Transit.—The current *Journal* of the Huddersfield (England) Chamber of Commerce contains an article on pilferage and packing, in which attention is drawn to the systematic thieving in connection with goods in transit, and the question is raised as to what extent packers are responsible. "It is safe to say that if all goods, at all times, were as much at the mercy of thieves as are 'goods in transit' the business world would have to put up its shutters, because it could not carry on." While losses are directly due to thieves it is suggested that it is nevertheless a fact that very often 'the sight of means to do ill deeds *makes ill deeds done,' and one fault of present day* shipping practice is that it affords many opportunities to "make a thief." The object of packing, we are again reminded, is not merely for the protection against damage, but for security against theft.

Harnessing Small and Medium Height Waterfalls.—A new and quite simple type of turbine has been introduced in Germany. It works with any quantity of water from 26 to 1,300 gallons per minute and a varying head of from 6 to 300 feet. The new machine is an adaptation of the Poncelet waterwheel, the water first passes through buckets to the interior of the wheel exhausting a large portion of its power, and then enters the driving wheel a second time from the inside through a covered guide wheel and parts with the remainder of its energy. The net result is a compound action which gives a useful effect of rather more than 80 per cent, continues *The Technical Review*. The turbine shaft is placed horizontally and the water may *enter through a pipe thus enabling the turbine to be* coupled direct to a generator, or, if desired, it can be placed in an open pit. It rotates at a high speed which is easily regulated while running by an adjustable governor.

Putting Waste Metals to Work

Methods and Machines That Make It Profitable for Every Plant to Handle Its Own Junk

By Robert G. Skerrett

A pulley type of magnetic separator treating foundry waste

THE salvaging of our metallurgical derelicts has become a business of imposing proportions, and the more we persist in this form of conservation the better able shall we be to hold our own in the near future in that keen industrial competition which is bound to tax productive cunning to the utmost

The old bit of lead pipe, the odds and ends of cast off iron, the battered door knob, the leaky faucet, the tinsmith's waste, the copper kettle that has served its day, and thousands of other articles of allied sorts have long been classed in the popular mind as junk To the man in the street they have fulfilled their primary purpose and are fit only for the scrap pile It is well, however, that there are others among us who do not look so indifferently upon these waste materials In the language of our Government experts such scrap is today dignified as "secondary metals", and their value in the course of a single year reaches a total of tens of millions of dollars

The war we waged upon waste during the recent period of strife brought home to us how spendthrift we were ordinarily, and practices were then instituted which can be of incalculable good if we persist in them nationally henceforth From now on the aim of our factories and mills must be to realize quantity output with a stricter regard to the costs involved The problem is not going to be one of promptness of delivery so much as profit at an attractive price We have got to count the pennies and put to service metals, for instance, that formerly were thrown aside with little heed to their possible re-employment Indeed, in some fields, we may be called upon to reuse a given quantity of metal several times in the course of a comparatively brief interval And what have we already done in this direction?

In 1915 the value of the secondary recoveries from six metals amounted to more than $114,000,000, and the U. S Geological Survey reports that secondary copper, brass, lead, zinc, tin, antimony, aluminum, and nickel reclaimed two years ago represented $181,841,500 And what about iron and steel scrap and the various ferro-alloys that were remelted during 1919? It is estimated that this particular group of secondary metals bulked substantially 8,000,000 tons and that they ranged in value from seven dollars to several hundred dollars a ton This happened in a year when our railways were yielding only about 60 per cent of their normal supply of old iron and steel

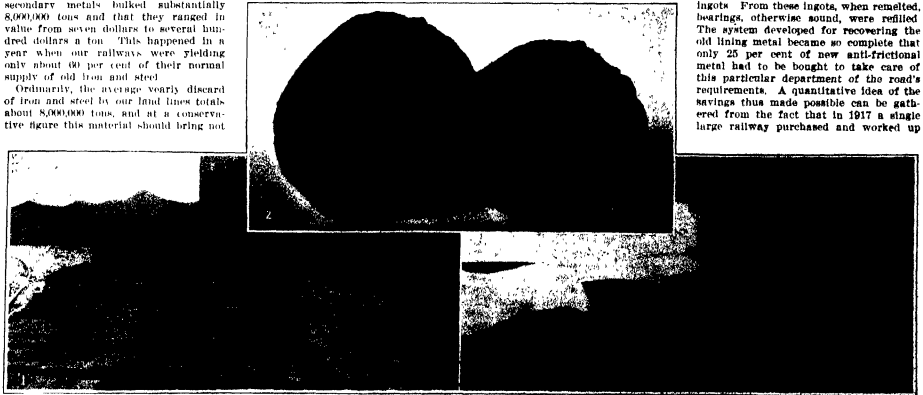
Ordinarily, the average yearly discard of iron and steel by our land lines totals about 8,000,000 tons, and at a conservative figure this material should bring not less than $100,000,000 This seeming wastage is not hard to understand when we recall how extensively iron and steel figures in the equipment of the rolling stock and the roadbeds of these great and far-reaching common carriers So much for the baser metals, and now for some of those of the rarer short that are made fit again for service

The secondary platinum, iridium, and palladium recovered from domestic sources in 1919 was worth $8,053,265, and was more than the value of the platinum and allied metals which we imported for consumption during the same twelvemonth It may never have occurred to you that when you parted with a filled tooth you were perhaps contributing to a veritable bonanza, but it seems that dental waste and jewelry furnish the largest share of secondary gold, while silverware and photographic waste yield us most of our secondary silver. According to the Government authorities, the gold or silver contained in old jewelry, dental waste, silver tableware, ornaments, and other articles remelted two years back was in excess of $27,592,060 Mints and refineries reported the recovery of 6,463,002 fine ounces of silver and $19,854,398 in gold from refuse or discarded material.

In the course of a twelvemonth one small refinery reclaimed 80,000 ounces of silver from the waste of some moving picture laboratories. Those familiar with the business are aware that a considerable part of well-nigh every new film is spoiled or cut out before the reel is displayed, and, besides, old films are scrapped All films contain silver in their coatings, and so do the solutions in which films are originally developed It pays to adopt measures to salvage this precious metal.

As many of us know, the lead-in wires of electric light bulbs are commonly made of platinum because the coefficient of expansion of that metal is so low that it will stand wide variations of temperature without tending to crack the enveloping glass. In the past little was done to recover the imbedded filaments in cast-off globes; but an example was set in the direction of conservation during the war at the house of correction of a large Western city. A testing plant was created for the examination of discarded light bulbs found in the municipal waste. Not only was a sufficient number of good lights thus discovered to meet the needs of the entire institution, but platinum that sold for more than $9,000 was reclaimed from the "dead" lamps

Not long ago the repair-shop foundry of one of our big trunk lines devoted half of its time to the manufacture of new bearings for its rolling stock, but by improved practices this work was reduced nearly 40 per cent The bearings proper are of bronze and lined with an anti-frictional composition. The remedy adopted was to melt out what was left of this soft metal lining whenever the bronze bodies came into the shop and to recast the lining material into ingots From these ingots, when remelted, bearings, otherwise sound, were refilled The system developed for recovering the old lining metal became so complete that only 25 per cent of new anti-frictional metal had to be bought to take care of this particular department of the road's requirements. A quantitative idea of the savings thus made possible can be gathered from the fact that in 1917 a single large railway purchased and worked up



Left: Briquets of flue-dust being carried by a belt conveyor from a briqucting machine to the blast furnace. *Above*: Partly consumed flue-dust briquets, showing how these hold together while undergoing melting in the furnace. *Right*: Machine for the briqueting of borings, turnings and millings from machine-shop waste. The finished blocks are discharged from the elliptical opening at the lower left of the view

How scrap is compressed into large cakes where it could not profitably be handled loose

21,000,000 pounds of bearing metals to carry the loads superposed upon the journals of the line's myriad car and locomotive wheels.

In machinery of all sorts brass and bronze figure extensively, and these metals, when scrapped, are not infrequently associated or mixed with iron and steel. This is especially true in machine shops where the turnings from lathes, etc., dealing with various materials, are swept up together and dumped in common piles. Miscellaneous scrap of this character is of little or no value as it stands, because there should be no iron or steel in brass castings and no brass in ferrous ingots or castings. It is therefore highly desirable that the ferrous and the non-ferrous metals be segregated so that they may be made ready for remelting. This could not be done cheaply and rapidly on a commercial scale but for the evolution of magnetic separators, which are obtaining steadily increasing recognition in our industrial life.

It has been said that a handful of iron will ruin a hundred pounds of babbitt metal; and iron in brass and copper alloys is likely to occasion grave trouble in working up the castings. This is owing to the manner in which iron forms into small nodules which absorb all of the carbon in the surrounding non-ferrous mass and become harder even than the hardest of tool steel. If, for example, the cutting tool strike any of these while machining a brass casting the instrument is apt to break, and, apart from the money loss in the damaged tool, the latter may injure the casting before the operator is aware of it. Plainly, much is to be gained by separating the antagonistic metals.

Where borings and turnings are very oily it is needful to remove this coating before separation begins, inasmuch as the oil causes the iron particles to stick to the other metals and thus to draw the latter along with the iron. This objectionable oil can be got rid of by various means. In general, in handling mixed metals, it is advisable to screen the chips through a half-inch mesh before feeding them to the separator. For the treatment of a combination of iron, steel, brass, copper, aluminum, or nickel scrap of this character, what is known as the disk-type of separator answers admirably.

In a machine of this sort the magnets consist of a large, stationary, primary magnet body and a series of small, secondary induced magnets which are mounted upon a rotating disk. The primary magnet has heavy double coils and cores with pole pieces projecting downward and conforming to the circle of the disk. The secondary magnets, made of Swedish iron, are inductively energized by the primary magnet, but become demagnetized as they sweep beyond the neighborhood of the primary poles and when so weakened they drop any iron or magnetic material that they may have attracted. In this way the discharge falls into a conveyor and is transported to a near-by box or bin, while the non-magnetic substances are carried to another point of deposit.

For handling bulkier materials there has been devised a pulley-type of magnetic separator. In apparatus of this kind the magnetism is strong enough to exert itself at a given point through the conveyor belt that turns about it. In operation, as the mixture comes within the magnetic zone of the pulley, the magnetic bodies are attracted and carried around and beneath the magnet where they are released and free to fall into a receptacle,

(Continued on page 415)

Two magnetic-pulley separators, on either side of a disk separator, also of magnetic type

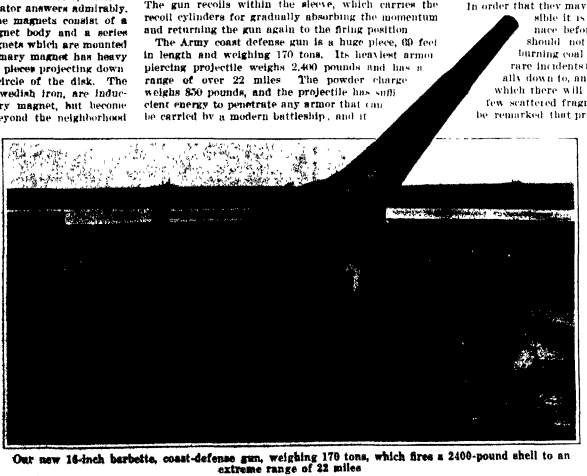
Our New Sixteen-Inch Barbette Coast-Defense Gun

IN our issue of January 29th of this year we described and illustrated the new 16-inch, 170-ton, disappearing, coast-defense gun, a type which is to be mounted in some of our most important fortifications We now present a photograph of the same gun on the new barbette mount, which has been designed by Army Ordnance and built at the Watertown Arsenal The mounting shown in this photograph is the first of its type to be built.

The disappearing mount, it will be remembered, was designed to permit the loading and sighting of the gun to be done below the shelter of a massive sand-and-concrete parapet, with a view to giving protection to the gun and its mounting and the crew After the gun is loaded, it is raised by its counterweight until the barrel is clear of the parapet, and on firing, the energy of recoil carries the gun back and down once more into the loading position. The barbette mount is simpler, inasmuch as the barrel of the gun is permanently exposed above the parapet The mounting consists essentially of a carriage and a sleeve, the carriage rotating horizontally on a turntable and the sleeve rotating vertically on journals which form part of the carriage The gun recoils within the sleeve, which carries the recoil cylinders for gradually absorbing the momentum and returning the gun again to the firing position

The Army coast defense gun is a huge piece, 69 feet in length and weighing 170 tons. Its heaviest armor piercing projectile weighs 2,400 pounds and has a range of over 22 miles The powder charge weighs 850 pounds, and the projectile has sufficient energy to penetrate any armor that can be carried by a modern battleship, and it can effect this penetration at any range

The recent firing tests against the old battleship "Massachusetts," carried out by our Coast Defense Artillery, demonstrated the great effectiveness of high-angle fire, and this mount has been designed so that the gun can be fired at an elevation of 65 degrees A 2,400-pound shell fired at such an elevation, and falling as it would, almost vertically from a height of several miles, upon the deck of a ship would unquestionably penetrate to the vitals, even were she a 43,000 ton vessel with the great protective armor of our new "Indiana" class It is a pretty safe guess that the effect of such a shot would be to cause the ship to fall out of line



Our new 16-inch barbette, coast-defense gun, weighing 170 tons, which fires a 2400-pound shell to an extreme range of 22 miles

Tin Cans as Fuel

IT might be left to the expert metallurgist to say whether or not there is any material quantity of heat evolved in the burning of tin cans and if so just what their "fuel value" is As an efficient and sanitary means for disposing of them there can be no question regarding their cremation

That almost any quantity of tin cans can be conveniently disposed of by burning in an ordinary hot air or steam house-heating furnace cannot be generally known to householders at large or there would be less back yards, vacant lots and dumps cluttered up with this most unsightly and insanitary kind of refuse As usually thrown out without the formality of rinsing, they are "smelly" and where they not infrequently lodge, they collect rain water and become most luxuriant breeding places for flies and mosquitoes All this could be readily avoided by simply "firing" the cans into the furnace along with the other fuel. The burning of a tin can, as any other combustible, is a process of *oxidation* Oxidation takes place slowly in the space above the fuel bed, because then if the fire is intelligently handled and there is a minimum of "air dilution" there will be *no great amount of free* oxygen. As the cans are allowed to sink deeper and deeper into the fuel bed, and, finally, into the underlying bed of ashes, they encounter more and more free oxygen which, at a comparatively high temperature, soon results in their almost complete disappearance

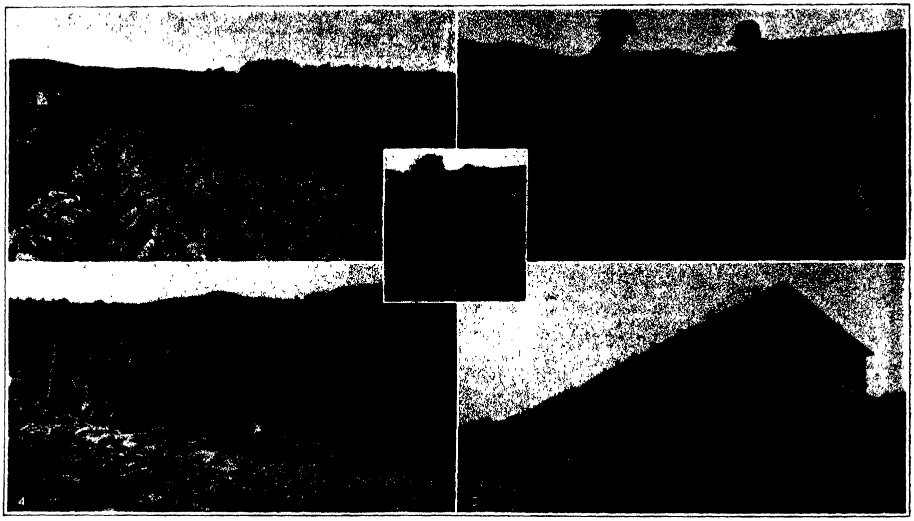
In order that they may be got rid of as quickly as possible it is best to put them into the furnace before firing on fresh coal They should not be "poked" (neither should burning coal for that matter, except in very rare incidents), but left alone to sink gradually down to, and finally through, the grates, in which there will be nothing left of them but a few scattered fragments of brittle oxide It may be remarked that practically all other refuse from the house can be disposed of in the same way

To the city dweller this information may be of minor interest although it does not require a very vivid imagination or otherwise active mind to show what an improvement there would be in the outskirts of every city infested with "dumps" if all combustible matter were disposed of in this way The refuse from the usual dwelling house would be one product and one product only—a mixture of fine ashes and clinkers, the former of which in the case of the rural and suburban owner can be readily separated out by dumping on an inclined screen for use in lightening the soil of the garden, and the latter, constituting about 50 per cent by volume, can be disposed of in the usual way or used in making concrete

The Fragrant Weed

Some Interesting Details in the Art of Tobacco Culture as Practiced in This Country

By William Henry


1. After cutting, the tobacco is allowed to lie in the sunshine to wilt. 2 Spearing the tobacco, four plants are impaled on a stick to facilitate handling 3. Using an axe to cut the tobacco plant. 4. The sticks with their impaled plants are loaded on a wagon for transfer to the barns 5 The immense drying barns have every alternate board hinged, to provide for the free passage of air

Getting our domestic tobacco from the fields of Connecticut to the factory

IT is believed that there are over fifty different species of the tobacco plant, nearly all of which are natives of the American Continent. Only a few of these varieties, however, are cultivated for use in the tobacco industry

One variety at least (*Nicotiana Affinis*) is used quite extensively as a decorative plant for horticultural purposes, not only on account of its beautiful, white, star-shaped flower, but also for the exquisite perfume emitted toward evening as the dew begins to fall

Tobacco may be grown successfully all the way from Canada in the north to Chili in the south, and on a great many kinds of soils, but the soil has so marked an effect on the quality of the leaf that different localities become famous for the excellence of the product raised there

In Cuba the very finest tobacco is grown in the Vuelta Abajo region The Connecticut valley has also long been famous for the quality of the tobacco raised there

In the Connecticut valley, however, hailstorms very often ruin a great part of the crops, and nothing will damage a tobacco field so quickly as a hailstorm Scientists have not yet been able to explain why the Connecticut valley should be visited by these violent hailstorms Last year (1920) quite large areas of tobacco fields were destroyed, as the hail cut the leaves to pieces, rendering the crop useless

The soil in the Connecticut regions is suitable for the fine quality of leaf used in the making of wrappers and binders for cigars, this soil being a sandy loam The leaves for fillers or inside of the cigars are mostly grown in Pennsylvania, the Miami valley of Ohio, in the Onondaga district of New York and in some regions in Georgia and Florida, the soils required for these purposes being much heavier than that needed for the binder and wrapper of the cigar, but the product does not command such high prices.

For the general manufacturing and export trade, a variety called White Burley is extensively grown, principally in the blue grass region of Kentucky, southern Ohio, West Virginia and southeastern Indiana This variety is light colored and possesses capacity for absorbing the flavoring materials used in making the plug tobacco

The seed of the tobacco plant is very small, and when sown in the cold frames it is usually mixed with wood ashes or land plaster to show how evenly distributed the seed has been From the middle of March to the middle of April is the best time to sow the beds in the Connecticut district, and the frames are covered with cheesecloth or glass.

When the plants are about 6 inches high they are ready to transplant, usually from the middle of May to the beginning of June The fields must be well prepared and heavily fertilized or manured

The plants are set about 17 inches apart, in rows from 3 ft 3 in to 3 ft 6 in. In large areas a transplanting machine is used to plant the fields

From now on frequent cultivation and hoeing must be done until the plants are large enough to cover the ground. The tops and suckers are then broken off so as to allow the better development of the leaves.

Harvesting the crop begins when the leaves assume a light shade of green, with light tinted flecks, indicating the ripening of the leaf

There are two methods of harvesting the crop—one in which the bottom leaves are picked by hand as they ripen, and arranged on sticks or strings to hang in the curing shed. The other method (and which is more generally used) is to cut the plants near the root and leave them in rows to wilt in the sun, so that the plant will not break in handling

The next process is to "spear" the plants; that is, spit a half dozen plants on a lath about 4 feet long, using a removable metal spear-head on the end of the lath, sliding each stalk along. The laths with the plants are now loaded on a wagon and carted to the large barns, where they are hung in tiers about 12 inches apart and at least 3 feet above the ground. These barns have the sides with alternate boards hinged so as to allow free passage of air and proper ventilation.

The curing of tobacco is one of the most important operations, as the color and quality depend a great deal on the way in which it is cured.

From five to eight weeks are required to complete the cure, as much depends on the state of the weather Artificial heat is used during cold or wet weather, charcoal fires on the floors of the barns being used, with but little ventilation.

After curing, the plants are then taken down and the leaves stripped from the stalks This is best done in damp weather, as the leaves are then pliable. The leaves are now placed in neat bundles, which weigh from 50 to 100 pounds and are ready for the market

As the leaves must undergo another process called sweating or fermentation before being manufactured, they are now, as a rule, handled by the packers, who make a business of the fermentation with their especially equipped plants. This part of the process is quite important as they have to control the humidity, ventilation and temperature. This operation continues from one to two years before the cigars are made

An idea of the immensity of the tobacco industry in the United States may be formed from the size of the internal revenue tax collected by the government.

In the year 1868 the tax was $3,097,620, and for the year 1919 it had grown to $204,982,580.

North Carolina leads all the other states in the amount of taxes collected, being followed in the order named by New York, Virginia, Pennsylvania, Missouri, Ohio and New Jersey, which are the principal tobacco growing regions.

Britain's First Commercial Airship

THE first British-built airship adapted to commercial service is the "R-36," her civil registration mark being G.F.A.A.F. She was designed by the Admiralty more than three years ago for naval duties and is a progressive development on earlier types of airships, although she does not embody the marked improvements in design which have been inaugurated during the past year. The "R-36" is the product of the Inchinnan Airship Works of the William Beardmore & Company, Ltd. Construction was begun in the early part of 1919, following the completion and handing over of the "R-34" Completion was deferred, owing to changes in airship policy.

In brief, the "R-36" is 627 feet in length, which is approximately 40 feet less than the length of the "R-34" The maximum diameter of the ship is 78 feet 9 inches It has a maximum gas capacity of slightly over 2,100,000 cubic feet, giving it a nominal lift of 63 8 tons. The maximum speed is 65 miles an hour, while its normal cruising speed is slightly over 50 miles an hour. It has a maximum range of action of over 4,000 miles However, the economic range varies according to the number of passengers and the weight of the freight carried

The design is quite similar to the well-known Zeppelin rigid type, with a gas containing hull comprising a stream-line skeleton framework of light metallic girders, covered over with heavy fabric. The hull is divided into nineteen compartments, each containing a drum-shaped gas bag. Each gas bag has an automatic gas release valve, while some are fitted with a manually-controlled valve, in order to discharge gas while landing or to alter the trim of the ship Inside the hull and along the bottom runs the gangway or "cat walk" for the entire length of the ship The petrol tanks and water ballast bags are arranged along this gangway

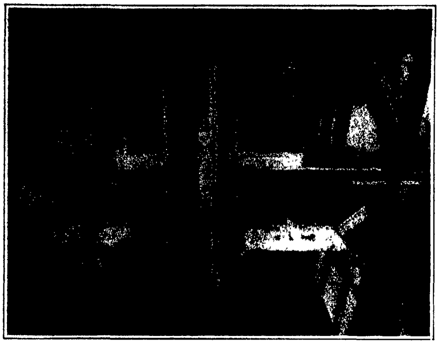
The "R-36" is fitted for mooring at a mast, and at the extreme bow is a trap door, opening outward, which enables passengers and crew to pass to and from the mooring mast when the ship is safely moored Six cars, five of which are designed to take power units, the sixth being a passenger car, the forward portion of which is used as the control car, are also features of this British airship. Two of these are "wing" cars, placed near the bow of the ship, each containing a 260-horsepower Maybach engine driving direct a two-bladed propeller. The passenger car is placed almost amidships and opposite its center are fitted two or more wing-power cars each of which contains a 350-horsepower Sunbeam "Cossack" engine The fifth power car is on the central line of the ship, toward the stern, and also contains a 350-horsepower Sunbeam Each of the three Sunbeam engines drives through a reduction gear and clutch a large two-bladed propeller These power units give a total of 1,570 horsepower, which is substantially more than that of the "R-34"

Four large fixed stabilizing fins are fitted at the tail of the ship, comprising two vertical and two horizontal members

An entirely new departure in British airship construction is the fitting of a passenger car which has been designed to accommodate 50 passengers. The car is 131 feet long It is provided with a passage way that runs down its center On each side are cabins which are furnished with beds for two passengers, a table and chairs as shown in the accompanying illustration The general arrangements of the cabins are such that each passenger is provided with a clear and unobstructed view, both inside and outside. The cabins are divided off by curtains at night, which may be drawn back during the day and the beds folded up. The car is also fitted with a cook's galley and a pantry, which are situated in the center of the ship. Good washing and lavatory accommodations are also provided.

A normal crew of four officers and twenty-four men is carried. The officers consist of a captain, first officer pilot, second officer pilot, and engineer officer. The crew consists of 2 coxswains, 7 riggers, 13 engineers and 2 wireless operators The crew is divided into watches which take alternative spells of duty and rest

The "R-36" is to be used for long-distance air service, in which it is certain to effect a great saving in time over existing transportation systems On the England to India service, for instance, the airship voyage would require approximately six days as compared with the fastest overland and mail route of twenty-one days The "R-36" promises to surpass the service of the German passenger airship, "Bodensee"



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Passenger quarters in the British airship "R-36" which is now available for regular commercial service

Circumventing Orange Thrips by Cleaning Orchard

THE thrip is an insect of economic importance which does extensive damage in orange groves Although a thrip-scarred orange is exactly as good to eat as a clean orange, the appearance of the fruit, and its consequent selling value, is very much reduced Any orange grower will tell you that a big crop of thrip-scarred oranges will bring less than a small crop of clean fruit

A logical orange grower had heard many times that dead leaves and litter in the vineyard were a serious peril, because they sheltered injurious insects He reasoned that what was true for grapes might well be true for oranges, and straightway made it an annual practice to rake his orange orchard free of leaves and litter late each fall Intelligent farmers often conduct such experiments for themselves, from long experience holding themselves ready for any result They realize that some little factor, not taken into account, may destroy the strength of their whole argument

But this orange grower who fought thrips by raking up leaves and litter each November met with success beyond his expectations He has followed the practice for several years now, and his orchard produces the cleanest fruit in the whole district The past season the thrip scarred oranges averaged not more than one or two to each tree Other orchards, unraked, in the same locality and growing under similar conditions, suffered heavy damage from thrips

This grower is conservative. He believes he has hit upon the ridiculously simple, remarkably inexpensive, way to control thrips, and certainly results seem to bear him up But he suggests that before accepting the experiment as conclusive demonstration, other orchardists should try it out They will, too! The solution of many an agricultural problem is so simple that it hides, as it were, in its own simplicity. At any rate, it wold seem that this simple expedient of clearing the orchard of leaves and litter is nothing more than what has long been done in other lines to avoid insects

"Mayflower", Challenger for International Fishing Schooner Cup

JUST at the very time when the ultra-refinement of the hulls and spars of yachts built for the America's Cup races had been carried to the point of absurdity —as witness the refusal of "Resolute" and "Shamrock" to race in the only decent breeze that came their way last summer—at this very time the stout, down east fishing schooners of Massachusetts, Maine and Nova Scotia came to the rescue.

These craft are staunch, able, strongly built schooners, which are perfectly at home in the heaviest water that may come their way in the Atlantic, and at the same time can do their 12 to 12½ knots as they race to the westward to carry their catch to the home markets

Last year's fisherman's race went to the American schooner, and new vessels are being built for the races of the coming summer Boston has entered the lists by building the handsome schooner of which we show an excellent illustration The "Mayflower," as she is called, was designed by W Starling Burgess, well-known son of a famous father, Edward Burgess, who was the designer successively of the "Puritan," the "Mayflower," and the "Volunteer," all three of which successfully defended the America's Cup Everybody will agree that so far as this picture can tell the story, the "Mayflower" is an able boat with a handsome sheer, high freeboard and a well-cut suit of sails

With each succeeding contest the competition will grow keener, and the successful schooners will be a little faster than their predecessors If there should be some good spanking breezes for this season's struggle, it is quite possible that records for speed, in reaching at least, will pass from the America's Cup to the Fishing Schooner Cup class

The "Mayflower", 141 ft. long over all, 11,000 sq. ft. of sail, designed as a competitor this summer for the annual fisherman's race

The Truth About the Dye Industry

Its Achievements and Its Status, and What Its Continuation Means to America

By H. Gardner McKerrow

THERE has been a great deal said, since 1914, about dyestuffs and the industry that makes them. Some of this has been outright German propaganda, much of it has been more or less hysterical in its nature. We believe it altogether in order to make a plain statement of what the dyestuff industry has been called upon to do since the outbreak of the war in Europe, the degree to which it has succeeded in doing it, and the precise position which this industry occupies and ought to occupy in our economic and political fabric. Mr. McKerrow is about as well informed on all matters connected with the production and marketing and use of artificial colors and the coal-tar chemicals from which they are obtained, as anybody in America We have asked him for such a statement; and here it is.—THE EDITOR.

THERE is nothing which enters so completely into the daily life of man, and is more essential to his contentment of mind, than color Color is to the mind of man what salt is to his food.

Imagine, for instance, what this world would be like if all artificial color were eliminated from our daily experience, from our clothes, the decorations of our houses, the woodwork with which we are surrounded, and the magazines and books which we read. Suppose that everything was a dead, toneless white, relieved only by the light and shade caused by reflections This is the actual condition with which we were threatened upon the outbreak of the European war in 1914.

Prior to that time we, and all other industrial countries, were entirely dependent upon coloring matters coming from Germany, and our complete line of textile fabrics, paper, leather, woodwork, paints, pigments, varnishes and everything else requiring color, drew their tints from the products of the great German dye-making plants

The discovery of coal-tar colors was made in 1856 by an Englishman, William Henry Perkin, but the development of the coal-tar industry very quickly passed into German hands, so that by 1875 England, France and the United States had become content to leave the development of this fundamental industry entirely with German chemists

Prior to 1914, as far as the United States was concerned, there were only five firms engaged in the manufacture of coal-tar dyes, and these depended for the most part, on intermediate products obtained from German manufacturers It may readily be supposed that these German manufacturers only allowed such of these intermediate products to come over here as would produce colors which could not, under any conceivable circumstances, compete with the finished German products The business here was not a profitable one, and with the single exception of aniline oil, no coal-tar product made in this country could be considered as having created a place for itself on a competitive basis

The German dyestuff houses established their own depots of distribution and their own laboratories in this country, and the technical service which they rendered to the dye consuming trades reached such a state of organization that our color users were riveted almost inseparably to the German manufacturers

When war was declared in 1914, this supply on which more than $5,000,000,000 worth of our industries depended, was instantly cut off, and no dyestuffs were available other than what remained in the hands of the German agents or in the warehouses of the mills themselves Immediately a condition bordering upon panic developed and prophecies were freely made that we should be reduced to the condition of a white world with color entirely eliminated from our every day life The very floors of the warehouses were scraped for color, all kinds of blends and mixtures were made to get desired shades, and dyestuffs utterly unsuited for the required purpose were used Dyestuffs intended for dyeing cotton were used for dyeing wool or silk, and blends and mixtures were made that would not resist even the action of cold water

An interesting illustration of this was an instance which occurred during those hectic times, when there was an absolute shortage of dye for coloring stockings One large hosiery manufacturer succeeded in getting hold of a large lot of brilliant black dyestuff—which by the bye, was German dyestuff—made and intended for the express purpose of dyeing casket cloth, and the only requisite of which was that it should give a brilliant glossy black, with no requirements as to fastness against light or washing It is intended, in fact, to be black only during the brief period of use, after that there are no complaints. He dyed up several hundred thousand pairs of stockings with this dye, and the result was that the first time that these were washed they turned olive green. This was used as a flagrant instance of the poor quality of American dyes

Our mills were forced back into the use of the natural dye woods which our forefathers used, and which, on the advent of the coal-tar dyes had passed almost completely out of employment. Such dyeing materials as log-wood, quercitron, fustic, hypernic and natural indigo were called for and methods of dyeing rejuvenated which had been forgotten for years The machinery for using this class of dyes had largely been done away with in the mills, and this also had to be replenished at a time when the mechanical industries of the country were being called upon to the limit of their resources for war purposes. The forests of Mexico and Hayti were ransacked for anything which would yield color and every conceivable vegetable growth having any natural coloring value at all was experimented with for the purpose of obtaining the tints called for by our mills.

Prices soared to unheard of limits, and dyes which before the war were sold at 20 cents and 25 cents a pound very quickly rose to $2, $5 and $10 a pound. Some romantic stories are told of the fortunes made almost overnight in the dyestuff business during the years 1914, 1915 and 1916, and everybody that could get into the dyestuff manufacturing business did so. Instead of five firms being engaged in the manufacture coal-tar products, there came to be in less than eighteen months, 127 engaged in the making of dyestuffs and about 218 engaged in the making of coal-tar intermediates Many of these firms had no moral or economic right to be in the business, they did not have the necessary capital or the necessary chemical experience and knowledge, nor did they have the plants for making dyestuffs of a proper quality. The legitimate concerns, those which had been in the business before and knew something about it, were straining every nerve to develop their equipment and place themselves in a position to meet the demand.

How difficult this was may be understood when it is remembered how completely our chemical trades were called upon for war purposes, and as the war progressed, how our chemical staffs were brought into requisition in order to supply the Government with the necessary chemical supervision in the production of munitions of war. Upward of $200,000,000 of capital was invested in dye-making plants, and by the end of 1917 a very considerable percentage of the supply of dyestuffs called for by our color consuming trades was coming from American factories

There is no mysterious alchemy in the production of dyestuffs, a given chemical formula, provided its ingredients are of satisfactory purity, will give the same result, whether it is employed on the banks of the Rhine or in Buffalo, New York

The term "fast" used in connection with dyes has been one which has been very greatly misunderstood The average layman understands by a "fast" dye, one that will resist any and all reactions, either light, acid, alkali or washing As a matter of fact, there is no dye—and never was a dye—which will fulfil all these conditions. Even the German dyes may be fast to one thing and not fast to others. It is not generally known that there never was a single pound of German dye ever imported into this country which did not carry the stipulation "without guarantee."

Prior to the war this was the condition on which all our manufacturers bought their dyes, but they accepted the situation without demur, as the German dye makers were the only sources from which the dyes could be obtained, and they themselves were willing, while using the German dyes, to guarantee their goods

There has been so much publicity, and so much false and uninformed writing about this point of fastness however, that questions are being asked and stipulations are being made, which were never imposed on fabrics dyed with German dyes prior to the war. It is simply because of this publicity that so many of our retail stores have put notices on their goods such as "these goods cannot be guaranteed because they are dyed with American dyes."

American dyes have been made to carry the burden of all kinds of faults; faults of improperly mixed stock, faults of spinning, faults of weaving, faults of finishing; all have been passed down the line and have been loaded eventually on the long suffering American dyes This is a condition which only has to be called to the attention of a patriotic American merchant, and in most cases he very readily and gladly removes these misleading notices.

As the new dye industry becomes more standardized and is able to give sufficient time to the working out of the intricate problems involved, the education of the American dyer will proceed apace and these difficulties will be eliminated one by one. We are justified in saying, however, that the three hundred individual dyes now made by the American dye manufacturers are class for class, and type for type, just as brilliant, just as fast, and just as reliable as the corresponding types of German dyes.

This does not mean that in the brief space of five years we have been able to make all the dyes which were formerly made in, and imported from, Germany, but we can have a feeling of justifiable pride, as patriotic Americans, in the fact that in one-tenth of the time that was taken by the German manufacturers to build up their coal-tar industry, we have reached a point where we are supplying practically all the colors commonly required for use in the daily life of the nation, and that there is but a short way to go to make our line as complete and fully developed as the German line ever was.

If the industry is permitted to live, and is not placed in a position where it can be wiped out by ruthless foreign competition, we are justified in believing that in a very few years from now, the coal-tar chemical industry of America will be doing everything industrially which was ever effected by German interests So much for the industrial side of the question.

There are other aspects, however, which are even more important than the individual interests of a certain number of our manufacturers. In the world's history, we have passed through a stone age, a bronze age, an iron age, a steel age, and we are now in a chemical age. Chemistry is entering into practically every branch of industrial manufacture. It will be called upon more and more for analysis of manufacturing conditions, and for synthesis in putting together the ingredients for achieving new purposes.

In order that this may be done intelligently, it is necessary to build up a thoroughly trained class of research chemists. Now, where are those chemists to come from? Certainly our colleges, even our technical schools, cannot be depended upon to produce them. No matter how well equipped or well organised these educational institutions may be, they can never do more than give young men the initial training in theoretical work. The practical application of this theoretical training must be done in some industry, the requirements of which are such that this work can be utilised in a commercial way.

There is no such industry, except the coal-tar chemical industry, and the collateral chemical manufactures that go with it. No other industry could afford to spend the necessary time and money on experimentation and the working out of complicated chemical processes. Given this necessary training in chemical research, the utilization of by-products can be elaborated and this brings us at once into a vast possibility of usefulness for the coal-tar chemical industry—which in itself would go far to justify its maintenance and protection—through the development of the by-products

(*Continued on page 417*)

The Giant of the Skies

The Size and Distance of Betelguese, and a Few Other Items of the Astronomer's Daily Business

IT means little to us to be told that Betelguese is 300,000,000 miles in diameter—little, that is, so far as concrete visualization of this huge size is concerned. We have a profound conviction that three hundred million is more than two hundred million, and less than four hundred million; but just what any of these figures mean, and just what the actual difference between them in concrete terms may be, is something that is by no means easy to comprehend. It is really necessary to build up from small beginnings in order to get any adequate idea of the size of this huge sum.

Even the attempt to make a comparison of some sort, graphical or statistical, is not one that will be necessarily and immediately successful. Anything, no matter how large it be, that is small enough for us to grasp readily and use as a basis of comparison, is pretty apt to be so very minute in comparison with Betelguese that the attempt at comparison leads us to a figure meaning little if any more than the 300,000,000 with which we started. An idea of the difficulty which inheres in the effort to get results in this direction may be gained if we try to compare Betelguese with the earth. The earth is a pretty good-sized affair, as things go in our ordinary life; it is probable that most of us have a fairly definite idea of what its 8,000-mile diameter really comes to, and rather doubtful that we have an equally clear visualization of anything much larger. But if we represent Betelguese by a sphere of 9 inches diameter, the very largest one that we can possibly crowd upon our opening page which is specially dedicated to displays of this sort, we find that the poor old earth will shrink to dimensions a good deal less than those of a pin-point—1/40,000 of an inch to speak in the round numbers which alone have any significance in the presence of a quantity determined no more accurately than is the diameter of Betelguese. We can't distinguish, on the printed page, between a point 1/40,000 inch and a point 1/400 inch in diameter—except perhaps on the ground that the one we can see, and the other we cannot manage to see at all

We are in a good deal the same predicament as that portrayed by one of the Einstein essayists, who wrote, apropos of the extremely small alterations in ordinary measurements called for by this theory, that while to be sure we can measure a million miles, and equally a millionth of an inch, we can't measure both these distances at the same time and place and with the same instruments. The difficulty in getting a graphic statement of Betelguese's size is altogether that of finding something comprehensible which can stand alongside Betelguese and be measured at the same time and place and with the same instruments. We believe the drawing which we present on the first page of this issue represents the most successful attempt yet made to do this.

The orbit of the earth and those of the other minor planets to be sure represent quantities with which we are not on excessive terms of familiarity Yet we can build up to them without undue strain or undue lack of clarity. The earth, for instance, travels in its course about the sun at an average speed of 18½ miles per second—1,100 miles, or much more than the distance separating New York from Chicago, in a brief minute This ought to give us some notion of the distance traveled by the earth in a year, which for the sake of those who want to be cautious we may state contains something like half a million minutes—one for every 10 feet of the long distance between New York and the metropolis on Lake Michigan. Yet when the long and weary path which these figures indicate for the earth's annual journey is bent around into a circle, we find that this whole circle with the vast expanse of empty space within it can be accommodated inside the solid (or liquid or gaseous) shell of Betelguese—accommodated so comfortably, in fact, that there is margin sufficient to admit the next planet beyond us—Mars—with his orbit that is pretty nearly half again as big as ours! That, roughly, is the state of affairs indicated by our drawing, which is laid off to scale with extreme care

We shall have to admit one exception to this The little boy and the elderly gentleman whom we have employed as further illustration of Betelguese's prodigious size are not drawn to scale, we shall not attempt to conceal this fact from the inquisitive reader. We shan't apologize, however, we consider that the reasons for our failure to pursue consistency to the ragged edge and over the edge are sufficiently obvious Let it be merely repeated here what is briefly suggested around the edge of our drawing. The greatest muzzle velocity attained in any regularly manufactured hand rifle to date is 2,800 feet per second—approximately a mile in two seconds. If we take this velocity as standard; if we pretend that it were possible for a bullet once started at that speed to maintain it indefinitely, and if we so ignore the facts of gravitation as to suppose that such a bullet once started parallel with the surface of Betelguese could maintain this parallelism traveling in an orbit that would carry the bullet eventually back to its starting point instead of bringing it to "earth" a short distance away from the point of discharge—then we have all the raw materials of our second attempt to put Betelguese's size before the reader The fact is, that at this high velocity, a bullet shot around the star by a boy of 14 would not complete the circuit and hit the marksman in the back of the neck until he had attained the ripe old age of 70—it would be 56 years in flight

There is really more of interest about Betelguese than the mere figure stated for its approximate size It is so remote from the earth that, even when viewed from opposite ends of the 186,000,000 mile base-line provided by the distance across the earth's orbit, it appears to lie exactly in the same direction—in technical terms, its parallax is not observable This means that the trigonometric method of determining its distance, which is the most accurate of the several devices employed by the astronomer for this purpose, is not available, and we must descend to a comparison between its apparent brightness as measured photometrically, and its probable real brightness as deduced from what the spectroscope tells us about it But this means that there is a very considerable margin of error, since the determination of real intensities in this way is based upon theories which have not been and proba

(*Continued on page 419*)

"Einstein's Theories of Relativity and Gravitation"

The Book in Which Is Collected the Material Brought Out by the $5,000 Prize Contest

SOMEWHAT later than expected, but we hope better for the delay, and none the less welcome because of it, the volume presenting the results of the Einstein Contest is now ready for distribution. The effort has been made to get into these pages everything of value that has been brought out by the competing essayists This, on the grounds of space alone, has necessitated the enforcement of a rigid policy of excluding everything that at all smacked of duplication There were essays that were as good as some of those chosen for inclusion in the book; but essays whose viewpoints were covered, collectively, with such completeness by the ones selected as to make their inclusion impossible There were likewise essays which were amply good enough in their entirety for inclusion without the elimination of parts which were adequately covered in other essays; but the demands of space necessitated the elimination of such parts. To all the contestants whose work was good and yet not sufficiently distinctive to be got in, *in toto*, we wish to express our appreciation and our regret that they could not be accommodated.

The reader will doubtless be surprised, on opening the volume, to find that Mr. Bolton's $5,000 prize essay is not given the position of honor at the head of the procession. It does as a matter of fact precede all the other complete essays that are printed; but it has been judged advisable to precede it by several chapters of introductory material. The very excellent reasons for this are set forth in the preface and need not be repeated here, beyond the bald statement that the subject is one on which it is not fair to ask the layman to read without a certain amount of preparation This the introductory chapters are designed to give him, and it is earnestly hoped that the hint offered by their position will be taken, and that they will be read before the essays which follow them.

The chapters embodying this preliminary material seem to us to constitute, alone, ample justification for the book. The vocabulary of relativity, both with respect to its actual words and even more so with respect to the ideas which these words attempt to convey, is altogether new and strange to the layman Things are done, offhand and without explanation or apology, which it would never occur to him were permissible The shock to his common sense is too great, and the writers on the subject whose work we have seen have, with few exceptions, failed to make any sufficient effort to mitigate this shock by subjecting the reader to it gradually These chapters are written with the idea that it ought to be entirely possible to get any intelligent layman into a frame of mind in which he can form an appreciation of relativity; and we believe they establish the validity of this belief

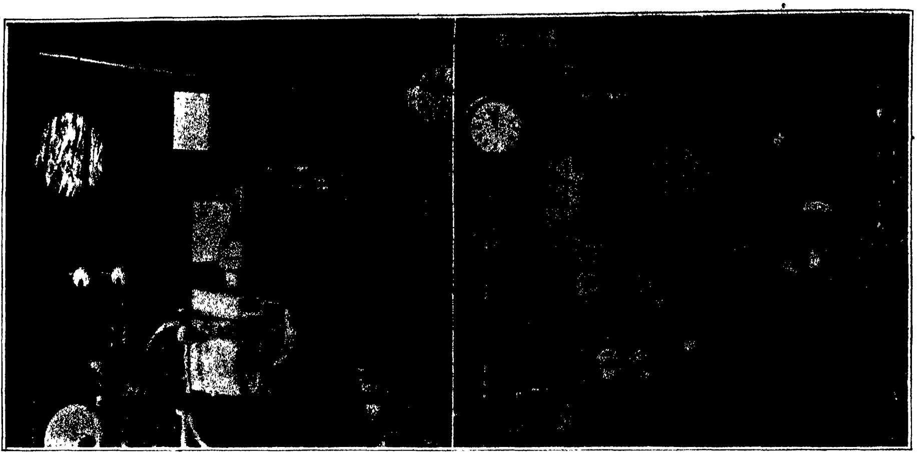
Everybody who has read the proofs on this part of the book has commented upon one feature, and inasmuch as this is a feature on the attainment of which the Einstein Editor spent a good deal of time and thought, he does not feel inclined to let false modesty permit it go unmentioned. In these 150 pages passages from 49 of the competing essays have been used—passages varying in length from a fragment of a sentence to several consecutive paragraphs. To these the editor has added material of his own—sometimes just a few words to bridge the gap between excerpts, again several pages on an item which he wished to cover in greater detail than he found it discussed in any of the essays.

If we were asked for an *a priori* judgment as to the readability of a patchwork composition of this character, we could give but one—it ought to be highly unreadable It ought to show its patchwork origin unmistakably. It ought to be chopped up to the last degree of discontinuity. But it isn't! We venture to state that in the absence of the reference marks identifying the various contributions, no reader would suppose for a minute that this was not the carefully executed work of a single author One with great versatility of style to be sure, able to adapt his mood to the thing he wished to say and the vein in which he wished to say it, but one able to write with skill in any of his styles Any single author might well be satisfied with a composition displaying the fundamental merits of unity, sequence, climax and proportion to the same degree in which they are here found We believe these chapters to be one of the most striking editorial achievements which we have seen

After this laying of the scaffolding over which the layman is to approach the subject has been completed, we come to the essays which are judged sufficiently good, and sufficiently distinctive in their presentation, to be given in full There is the winning essay by Mr Bolton of the British Patent Office staff, a model of clear and concise statement. Somewhat lacking in explanation as this essay has been found by some readers to be, its outstanding merit as a statement of the postulates of relativity and their consequences cannot be overlooked It will not stand alone to tell the lay reader all he wants to know or even all he needs to know about relativity—the contest has borne out our impression that in 3,000 words this was not possible, and that the award of the prize would have to be made to the essayist who, from the many things that clamored for saying, should select the most significant things to say. That every word which Mr Bolton says is significant should be the verdict of the reader

After the winning essay we find 15 more of the competing essays in whole or substantial part The preface assures the reader, and we reiterate, that no effort is made to arrange them in order of merit The whole idea is to present them in the order in which they shall most advantageously show up the subject They have been selected with extreme care, with the idea of eliminating duplication and securing a collective result which shall constitute as complete a discussion of the subject as was possible We believe both selection and arrangement are worked out with success.

(*Continued on page 419*)



Left Arc transmitter installed on the S S "Aeolus", which has communicated direct with the Navy station at Bar Harbor, Me, 8,000 miles in daylight, and has communicated nearly 8,000 miles at night, using the same amount of power as most marine installations *Right* The 2-kilowatt spark transmitter used on the "Aeolus" for emergency and for communication with South American stations which are not equipped for the reception of arc signals The spark transmitter appears at the right. In the center is the receiving set key and controls

Arc and spark transmitters employed on board the steamship "Aeolus", which has some remarkable records to its credit

Radio with the Arc Transmitter

The Remarkable Showing Made by This Type of Apparatus on the "Aeolus"

By Arthur H. Lynch

THE S S "Aeolus" of the Munson Line arrived in New York on March 28th, from South American ports The movements of this vessel are being watched with much interest by those in the marine industry, because she has materially reduced the running time between New York and Buenos Aires

In addition to clipping a few laurels for herself in the matter of speed, the good steamship "Aeolus" is also setting remarkable records in radio communication She has been equipped with a 2 kilowatt arc transmitter and boasts a very efficient receiver

An official report from the Chief Radio Officer to the company tells of direct communication with East San Pedro, California, the night the vessel left New York on her way south On the same evening she also sent messages to and received from the S S "Venezuela," which was very close to Honolulu Both these stations reported that the signals from the "Aeolus" were very strong and easily read

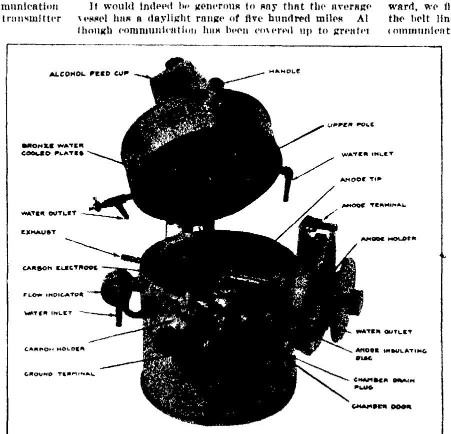
From New York to Honolulu is approximately eight thousand miles, so that communication covering that distance, with a transmitter which does not require any more power for its operation than the ordinary ship set, is very remarkable But even this great distance has not caused so much stir in radio circles as has the distance of 3,013 miles over which the vessel communicated in operating with the U S Navy Radio Station, at Bar Harbor, Me

After leaving New York it was possible for the "Aeolus" to communicate directly with Bar Harbor, night or day, up to the time this record was reached, which is quite remarkable, to be sure

Communication with the radio installations usually found on vessels, is a much simpler matter at night than it is by day, and though great distances have been reported heretofore, most of them have been accomplished at night. One theory for this difference in operating ranges is that there is a certain amount of energy absorption, caused by the sun's rays, during the bright hours Many other theories have been exploited and some exploded

The fact stands, in radio circles, that communication by night cannot be used in estimating the effective range of a transmitter, as it is always more or less "freaky" The significance, therefore, of the daylight range is what is relied upon

It would indeed be generous to say that the average vessel has a daylight range of five hundred miles Although communication has been covered up to greater distances, the instances are quite few and only have occurred in latitudes where there has been freedom from atmospheric disturbance. The nearer we get to the equator the greater becomes the atmospheric disturbance, called in radio parlance "static" And it is well known that the heavier the static the less possibility there is for communication by radio



Two-kilowatt arc generator employed for creating the continuous waves in arc transmission

By projecting a line from Bar Harbor, Me, southward, we find that the "Aeolus" was not so far from the belt line of the world, when she was in daylight communication with that station That is, in a position where receiving is admitted to be as bad as is possible and at a time of day when transmission is subjected to the greatest natural barriers, she sent to and received from Bar Harbor.

Considering that the operator overloaded the equipment a bit, in order to get through, we will say that three kilowatts were consumed instead of two At the rate of ten cents per kilowatt, which is about the average charge made for electricity, the current used for this remarkable feat would cost thirty cents per hour

Comparing this range with the ordinary daylight range of five hundred miles, which, as previously mentioned, is generous, there is an increase in distance of two thousand five hundred miles, which is five hundred per cent in favor of the arc transmitter over the less efficient sets

The work being done by the "Aeolus" is being carried on by many other vessels of the U. S. Shipping Board fleet, which have been equipped with arc transmitters In many cases unfavorable reports have been received by the Board concerning the operation of this form of transmitter, which, it is claimed, were caused by inexperienced operators or faulty installation, brought about by the rush of war. Many of the sets have had to be reinstalled, and the war-time operators, some of whom did not know the first thing about any

(*Continued on page 420*)

Mechanical Helps for the Printer

IN the business of printing there are many tricks of the trade that must be learned in order to turn out work that is up to standard. One of the most perplexing problems is that of keeping the sheets to be printed free from dirt and sediment before they touch the type form. If they are not absolutely clean there is no uniform inking and a clean impression is lacking. The printer has his troubles with the filling up of half tones, with sometimes a big resultant damage To overcome this trouble, usually after a few thousand impressions have been run off, the forms must be washed Mr. James E Doyle, a practical printer of Cleveland has perfected a vacuum sheet cleaner and when it is in use it is said that the washing of forms need be done but once or twice a day.

This device is very simple in design and can with very little trouble be attached to any cylinder, lithograph or offset press. It is operated by a small electric motor and has a series of suction nozzles. These latter are connected by rubber tube to a small suction fan The nozzles operate on the press cylinder at a point where the paper starts on its trip through the press Dirt, lint and other sediment is drawn from all paper and eventually finds itself in a canvas bag attached to the blower

Static electricity is another source of trouble for the printer If some attention were not paid to this trouble maker the printer would not be able to turn out his work as fast or jog the piles of paper as perfectly For this purpose an electrical sheet heater has been brought out by this same gentleman The heating element is of special construction designed for intense heat. The heating wire itself is of very recent invention and is the same as that used for high-temperature melting furnaces but is used for this purpose at one-third its capacity.

The electric sheet-heater attached to the press, with the heating member shown in the insert above

Vacuum cleaner that keeps the sheets clean, the impression uniform, and the plates free from clogging, shown attached, with the press in shadow

A Big Moving Job

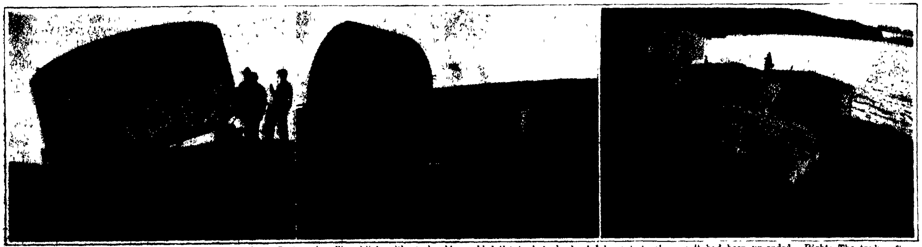
TEN large-sized steel tanks having served in connection with the manufacture of high explosives near San Francisco during the late war were just moved a distance of 25 miles to be used in a more peaceable oil-supply station In moving these tanks novel methods were used to save time and expense Each tank measures 22 feet 9 inches in diameter by 10 feet high, not including the umbrella shaped top which adds 2½ feet to the height. The bottom and shell are one-quarter-inch steel plate, the umbrella-shaped top No 10 gage steel. The capacity of each tank is 30,000 gallons, and the weight is 16,000 pounds empty

By means of 4-inch pipe used as rollers, with pipe flange at one end of the pipe to facilitate turning the pipe and moving the tank, each tank was moved from its foundation to the edge of a nearby bank, and tipped over the bank After this it was quite easy to raise them further on edge by means of an auto truck pulling on a rope block and cable

With the tank on edge, a rolling hitch with steel cable enabled the auto truck to move quite rapidly Some of the tanks were moved in this manner half a mile over rough rolling country. Grading had to be done in a few places only.

To get the tanks to the water's edge it was necessary to cross the railroad tracks at a very busy point The tanks were lined up ready to be rolled across the tracks at night, so as to give the least interference with train schedules

After being moved across the tracks the tanks were rolled into the water and towed down San Francisco Bay All ten of the tanks were towed at one time by a 110 horsepower launch making the trip against a brisk wind and part of the time against the tide, in eight hours


Left: Tipping a tank over the bank to get it on edge. *Center:* A rolling hitch with steel cable enabled the tank to be hauled by auto-truck once it had been up-ended. *Right:* The tanks after being rolled into the bay and restored to a natural keel

Moving ten big steel tanks by rolling them to the water

New Use for the Telephone

FISH when they swim make a noise, and this can be detected by the telephone according to the following:

Most of us have watched with interest the movements of shoals of fish beneath the surface of the sea or of a lake, but few will have associated with those movements the idea of noise Nevertheless, such movements do make a noise, and Norwegian fishermen, it is said, have taken advantage of that fact to devise an arrangement to assist them in detecting and locating fish at considerable depths They lower a microphone by means of a wire from their boat into the water, the other end of the wire being connected with a telephone receiver on the boat. As the latter slowly proceeds on her course in search of a haul, an operator keeps the receiver of the telephone to his ear and he can tell instantly when a shoal of fish is being approached

The Trend of Motor Truck Design for 1921

A PROMINENT eastern truck manufacturer who has built and tested trucks driven by chains as well as internal-gear and worm-drive axles has decided, as a result of these extensive experiments, to use an enclosed drive rear axle which he calls *a dual reduction type* This axle employs only two gear reductions, four gears being used in a gear unit that is a compact assembly located at the middle of the axle and driving the wheels through conventional live-axle shafts The rear axle is a full floating construction, the wheel being carried by two taper roller-bearings having opposed load lines, these bearings being placed on the outside of a strong one piece drop-forged load-carrying member that has a wide yoke at the center, encircling the gear unit The dual-reduction gear arrangement is very similar to that type which is so popular in England, France and in Germany for use on subsidy-type trucks intended for heavy-duty work and adapted for immediate conversion to military service The primary reduction is obtained by bevel-gearing while the secondary reduction is through a pair of spur gears The pinion being mounted on the primary reduction shaft while the large member with which it meshes is attached to the differential housing assembly Tests have shown that this dual reduction gear is nearly as efficient as side-chain drive and more efficient than the worm-gear drive

A Super-Dreadnaught as Target

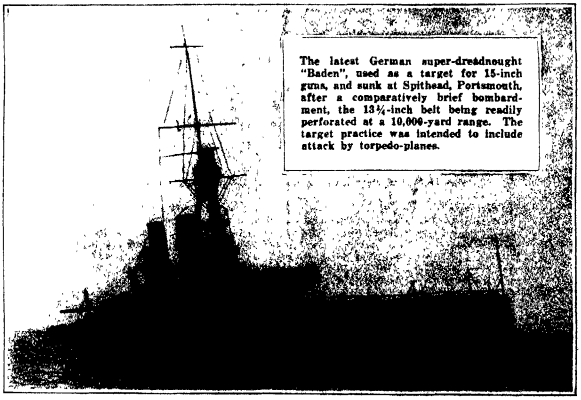
The Latest German Battleship "Baden" Sunk by Gunfire and Torpedo

By Hector C. Bywater

IT will be remembered that the terms of the Armistice, as far as they affected naval affairs, required of Germany that she hand over her fleet to be distributed among the Allies. The allocation of the ships was made with the understanding that certain larger units should be destroyed within a definite time. This condition is being fulfilled by using the ships as targets for attack by gunfire, torpedo or bomb. The accompanying article seems to dispose of the rather widely accepted belief that the German capital ships were possessed of defensive qualities which greatly exceeded those of similar ships in other navies of the world.—THE EDITOR.

EARLY in February the ex-German battleship "Baden," which was among the former enemy ships allocated to Great Britain, was towed from Portsmouth to Spithead and there subjected to attack by gunfire and torpedoes According to a semi-official statement issued on February 9, "the 'Baden' was subjected to short range firing in the presence of gunnery experts, and also to aerial torpedo attacks The object was to test the construction of German battleships and to throw light on the value of capital ships The ship will be salved for further tests." The photograph reproduced herewith was taken soon after the conclusion of the experiments As the first occasion on which a really modern war vessel of the largest dimensions has figured as a target ship, this experiment has created great interest in naval circles The "Baden," which was laid down in December, 1913, at the yard of F Schichau, Danzig, and commenced her trials in November, 1916, embodies the latest German ideas on battleship design The "Baden" is 590 feet long over all, has an extreme beam of 98½ feet, and her displacement at 27 feet 8 inches, 28,074 tons She represents the latest German ideas in battleship construction

As regards armor and protective plating, the "Baden has a main belt 13¾ inches thick, which tapers to 6¾ inches at the lower edge This is surmounted by a strake of 9⅞ inches armor extending to the upper deck, and the citadel is enclosed by transverse bulkheads Beyond the main belt there is plating of 6 inches up to the bow and stern The secondary battery is armored with 6¼-inch plating, the deck above the battery being about 1½ inches thick Deck protection is less substantial than might have been supposed The protective deck proper is only 1 3/16 inches on the slope, but abaft the citadel this deck increases in strength till it reaches its maximum thickness of 4¾ inches over the steering gear Forward of the main belt the protective deck is 2⅜ inches thick The barbettes have a maximum thickness of 13¾ inches, the turrets being 13¾ inches thick at the front, 9⅞ inches at the sides, and from 4 inches to 4¾ inches on the roof. The forward conning-tower is built up of 13¾ inch armor, with a 5⅜-inch roof The coal bunkers are so arranged that they extend all the way above the protective deck from the foremost to the aftermost barbette, and when filled with coal add considerably to the sum total of protection Armor gratings of the usual pattern are fitted to all openings in the forecastle and protective decks So much for the defense against gunfire


The latest German super-dreadnought "Baden", used as a target for 15-inch guns, and sunk at Spithead, Portsmouth, after a comparatively brief bombardment, the 13¾-inch belt being readily perforated at a 10,000-yard range. The target practice was intended to include attack by torpedo-planes.

In the "Baden," as in every other German warship of modern construction, great pains have been taken to minimize the effect of submerged explosions, an object facilitated by the generous beam of the ship The principal defense against torpedoes consists of a longitudinal bulkhead which runs throughout the major length of the ship. It has a uniform thickness of 2 inches, and is closed at each end by 1 3/16 inch athwartship bulkheads There is, in addition, a very elaborate system of pumping and flooding, which war experience showed to be more effective than mere passive resistance by means of subdivision When the ship went into action the commander was posted at a station below deck, where his sole duty was to keep the ship on an even keel. From his central station he could communicate by voice-pipe and telephone with the pumps, sea-cocks, and auxiliary leak-control stations. A pendulum showed him at a glance the exact trim of the ship, while a diagram board indicated the quantity of water which could be admitted to each compartment and the effect which flooding would have on draught, heel, and general trim. The whole ship's company had been thoroughly trained in this work, partly by periodical drill and partly by means of an instructional model, which reproduced in miniature the subdivision of the hull. Thanks to these careful precautions German ships which received in action injuries of the gravest description were brought safely into port, the "Derfflinger" and "Seydlitz" after the Jutland battle being cases in point

The "Baden" was armed with eight 15-inch, 45-caliber rifles in four center-line turrets, sixteen 5.9-inch 45-caliber rapid fire guns eight 3 5-inch 45-caliber anti-aircraft guns, and three 23 6-inch submerged torpedo tubes An interesting feature of the main armament is the extraordinarily light weight of the 15-inch gun, which weighs only 76 2 tons On the other hand, the projectile is much lighter than that of the British 15-inch gun, weighing only 1 652 pounds as against 1,930 pounds. Its muzzle velocity is 2,625 feet-seconds, and at 16 degrees (the maximum elevation of which the "Baden's" guns are capable) the extreme range is 22,200 yards. Of the three torpedo tubes fitted, the bow tube is horizontal and located 19 feet below the load waterline, while the broadside tubes are depressed two degrees and set at an angle of 20 degrees before the beam, the centers of the tubes intersecting the ship's side at points 13 feet below the load waterline. The torpedoes used in this ship are believed to be the largest extant. Their diameter is 23.6 inches, the length 28 feet, and the total weight 2.16 tons, of which 551 pounds is represented by the bursting charge. Set at a speed of 28 knots these formidable engines have a range exceeding 14,000 yards.

Before being fired at, certain modifications are understood to have been made in the "Baden," and the foremost turret was removed. Few authentic details of the bombardment are available, but it is known that the vessel succumbed far more quickly than had been expected. According to statements published in the press, the firing ship was the old monitor "Lord Clive," which during the war carried a pair of ancient 12-inch guns and, subsequently, a single 18-inch gun, with which she shelled the German positions at Zeebrugge For the "Baden" experiment the "Lord Clive" was fitted with a triple 15-inch gun mount, the first mount of this kind to be used in the British Navy. It is reported to be in contemplation for the four new battleships of the current shipbuilding program, which may therefore mount ten 15-inch guns in two triple and two double turrets, arranged as in the U.S.S "Oklahoma"; or, possibly, twelve 15-inch guns in four triple turrets, corresponding to the arrangement of the U.S.S. "Indiana" On this point, however, there is no definite information, and it is by no means certain that the designs of the new type have been finally approved Nevertheless, the fact that a triple mount for heavy guns has been made and experimented with marks a distinct epoch in the development of British naval ordnance and indicates the belated adoption of a system which has long been in vogue in the navies of the United States, Italy, Austria and Russia.

Although the "Baden" was shelled at short range, the velocity of the projectiles is believed to have corresponded to a range of about 10,000 yards The effect was surprising in view of all that has been heard about the super-excellence of Krupp cemented armor plate made at Essen. Round after round cleanly perforated the 13¾ inch belt, and in some cases projectiles impinging at an oblique angle punched their way right through the thickest armor Under this heavy punishment the great battleship soon displayed signs of distress. Water entering through the numerous shell holes 'twixt wind and water gave her a heavy list to starboard, and long before the specified number of rounds had been fired she heeled gently over and sank, coming to rest on the shallow bottom with most of her hull above water. It is not quite certain whether the torpedo-planes which had been detailed to administer the coup de grâce made their attack before or after the bombardment, but in any case one or more torpedoes were dropped from the air and are said to have found the target. Sir E. T. d'Eyncourt, the Director of Naval Construction, has stated that the "Baden's" armor showed a degree of resistance considerably inferior to that of British armor of the same dimensions. A further point demonstrated by the test was the great improvement which has been made in the quality of British armor-piercing shell since the Battle of Jutland. In that action, according to Lord Jellicoe, many shells broke up on striking the thick German armor, though there is photographic evidence that a large percentage got through and exploded with terrific effect inside the ships. Views have been published

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Spacing Trains the Correct Distance Apart

ON a railroad where the traffic is exceptionally dense, such as the subways and elevated railroads of large American cities, it is quite a problem to maintain an even headway or interval between trains. The loss of headway by any one train throws more or less of the entire railroad system out of joint, for with headways measured in minutes and seconds the uninterrupted operation of trains is as delicate as a complicated piece of machinery.

Of considerable interest in this connection is the hedwaygraph—an instrument that furnishes a daily record of railroad headways. Several instruments of this kind have been installed on the subway lines of the Brooklyn Rapid Transit system in Brooklyn and Manhattan. The hedwaygraph, which is shown in the accompanying illustration, is circular in shape and 24 inches in diameter. Every 24 hours a fresh paper chart is placed in the instrument, being held in place on a revolving disk that is driven by clockwork. The disk makes one complete revolution in every twenty-four hours On the chart are four circular sets of lines representing the tracks at the points selected for the recording of the intervals between trains. Radial lines divide the circular lines into 24 parts which represent the 24 hours. Between these hour lines are smaller ones which divide each hour into sections that represent one-sixth of an hour or ten minutes. At a fixed point directly above each of the four sets of circular lines is an electrode or "spark point" which, by the passage of a spark, marks the chart each time a train passes the chosen point and this makes a record in minutes of the intervals between trains.

When a train passes over the track at the point selected for checking up on headways, a relay connected to the track is automatically operated, which in turn operates two other relays in the chief dispatcher's office; and the action of these controlling devices is such as to energize momentarily an induction coil and produce an electric spark from the spark point above the chart. This spark produces a charred puncture in the chart about the size of a pin-hole Thus each of these small holes represents a train that has passed over the track at the selected point and the distance between the holes on the revolving chart represents the intervals between the trains

A Rocky Mountain Town Which Runs Its Own Plant

AN interesting example of municipal ownership of a public utility on a small scale which has apparently succeeded is presented in the experience of Longmont, Colorado, with its electric lighting and power plant.

Longmont is a pretty little town of 6,500 population, built on an elevation above the broad farming lands on the eastern slope of the Rocky Mountains, and is one of the principal gateways to Estes Rocky Mountain National Park. The business streets are well built and paved, with smooth boulevards stretching into the country, inviting the motorist, while the residence avenues are lined with tall trees and lighted by rows of electric globes on iron pillars down the middle of the avenues.

The first thought of owning an enterprise of this kind was stimulated by an article on "The White Coal of Switzerland" appearing in a leading weekly ten or twelve years ago. The rugged mountain scenery of the region may have suggested to the town lying along the base of the range that possibly similar benefits could be obtained by the development of its own natural resources.

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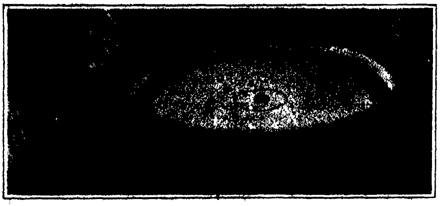

An instrument that makes a record of the headway between trains on one of New York's busy subway systems

Copyright, Keystone View Co

An automatic telephone installation in Germany which handles 10,000 numbers with only three operators

The Longmont power and water supply station which furnishes water and electric power to a Colorado community

Motor-oil barrels used as silos at the South Dakota Experiment Station, the hand-chopper being shown in foreground

The Automatic Telephone System Abroad

THE United States is not alone in the development and progressive application of the automatic telephone system It appears that the automatic method of telephone operation is rapidly gaining ground in Germany.

The well-known Siemens industries for the most part have lately been transferred from Berlin to Spandau where many of them were already located The co-ordination of such a vast grouping of industries into one giant organization naturally calls for an extensive intercommunicating telephone installation, and while in the past the private telephone system has been manually operated, it was decided to employ the automatic system at Spandau following the consolidation of all the Siemens industries So remarkable is the present automatic system now in use at Spandau that conversations may be carried on between any two posts in the entire plant without manual aid from Central "

The automatic system is not altogether new to the Siemens organization Ever since 1913 the plant had been served by an automatic board which was capable of enlargement to 6,000 numbers without any serious structural changes In Germany this is considered the equivalent of the telephone installation to serve a city of 200,000, though in our country with its much freer domestic use of the phone a similar claim would have to be made on a much smaller scale The new central station necessitated by the latest move is one of 10,000 numbers, and requires the service of but three operators to do the few things which the mechanism is incapable of doing itself It handles between 60,000 and 70,000 conversations per day.

The Electric Billy Goat and Its Work

OUR cover illustration shows a new type of electric "billy goat" hauling machine recently installed at the Beacon Park plant at Allston, Mass., for the Boston & Albany Railroad

For coaling locomotives this railroad has a large coaling plant consisting of a frame building containing large hoppers over which is a standard gage track on which the coal cars are run. This upper track is reached by a long grade of 26½ per cent A train of loaded coal cars is left on one siding and one car is pulled forward into position by a small electric car puller When the car reaches its proper position, the small car puller is disconnected and the large electric hoisting winch is started A "billy goat," which is of cast iron and which runs on wheels on a narrow gage track, is pulled by 1½-inch-diameter steel cable connected to the hoist drum This "billy goat" normally rests in a narrow concrete trench between the rails, and when pulling is started, it

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When Oil Barrels Become Silos

THE expense involved in establishing a costly, modern equipment for conducting numerous experiments with ensilage as a palatable food for cattle has been adroitly sidestepped by the Government Instead of constructing a silo plant, with all its costly appointments, the Forage Crop Investigations U S Department of Agriculture, acquired 10 motor-oil barrels at a cost of $1 50 apiece, and a hand chopper for less than $20

The improvised equipment was stationed at Redfield, South Dakota, the experiments having begun in the fall of 1919, and will be in continuous operation for an indeterminate period Preliminary tests were made with these mixtures Alfalfa and corn, alfalfa and sorghum, and sorghum and corn The barrels were filled on September 1, containing from 150 to 200 pounds of ensilage, and the con-

(Continued on page 420)

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

A New Internal Gear Drive Axle

THE popularity of the internal gear drive for motor truck use and its wide application in double reduction axles has stimulated design and development of this type, and various refinements have been worked out and applied in the construction of new axles recently announced. After an extensive and exacting series of tests, a distinctive and what has proved to be a very practical form of axle has now for some time been on the market The mechanism, which is clearly outlined in the accompanying sectional view, is simple and compact; and while all parts are easily accessible, they are thoroughly enclosed, run in a constant bath of oil, and are exceptionally well protected from the destructive possibilities of the abrading action of road dust There are no grease cups on the axle because the lubrication of all the internal mechanism is done by a simple circulatory system that cannot get out of order, since it uses no auxiliary parts such as pumps or delicate piping Only such members as are found in all axles are given the added function of contributing to the oil circulation in both braking and driving mechanism

Another feature that differs from conventional construction is the use of multiple disk brakes working on the live axle shafts, these being completely housed and working in a constant oil bath The work of bringing the truck to a stop is distributed over a large number of lubricated faces, and it is evident that heating is reduced and that there is practically no depreciation because of the low unit pressure on the friction material This design provides brakes of great efficiency and endurance, considerably less pedal pressure being required to bring the truck to a stop than is necessary with the conventional band-brake designs

The brakes are operated by a simple toggle mechanism which acts as an equalizing medium as well, while the pressure is gradually and uniformly applied to both brakes simultaneously, a demonstration on a wet pavement convincing the writer that skidding due to uneven braking was eliminated by the combination of equalizing actuating mechanism and disk in oil brakes A turnbuckle is included in each toggle link and adjustments can be made if extended service makes it necessary

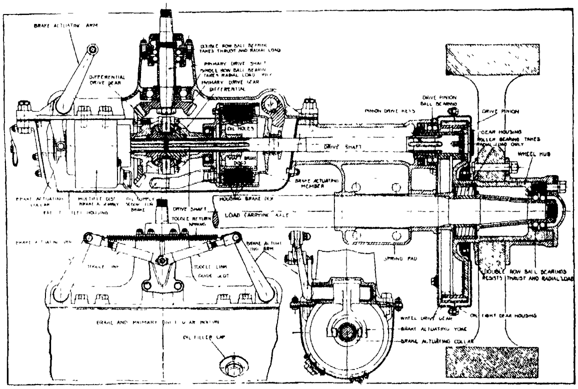
The oil circulation system through the brakes can be easily understood by referring to the accompanying drawing Oil collecting scoops are placed in such relation to the bevel gear attached to the differential that lubricant is forced into them by the rapid rotation of the adjacent mechanism This oil is directed to the interior of the brake disk carrier and is thrown to the periphery of that member by centrifugal force, passing through suitable holes and then between the brake disks, thus coating them liberally with oil The oil supply is constantly renewed because the oil is thrown tangentially from the outer brake-disk carrier, finding its way back to the gear housing and again being picked up by the gear Any heat absorbed by the oil is thus dissipated

It is said that the axle is free from noise because of the silent brakes and drive gearing as well as the absence of external unlubricated moving parts. Owing to the elimination of the usual large-diameter brake drums, the road clearance is exceptionally good and obtains at all points under the axle, it being as much at the wheel ends as at the center, a somewhat unusual accomplishment in double-reduction axle design. A clearance of more than 14 inches is secured with 36-inch solid tires.

The rear wheels are driven by herringbone gearing, which is very silent in operation and which eliminates end thrust As the power is applied well toward the rim of the wheel, the gear tooth pressures are low. An oil-tight casing holds a sufficient quantity of lubricant to provide for extended periods of operation. The oil is carried up to the driving pinion by the large internal gear and thoroughly lubricates that member and its supporting bearing Practically all the reduction is obtained at the wheel, so the differential mechanism and drive shafts may be made light without sacrificing strength, thus reducing unsprung weight.

The load carrying member is a one-piece, solid, drop-forged construction of heat treated alloy steel The hub is designed to take either wood or steel wheels and the assembly is such that a wheel may be dismounted without disturbing either the bearings or the drive gearing. As the axle embodies the Hotchkiss drive principle, the spring pads are attached to the driving-gear housing so the rear springs take all braking and driving torque reaction.

Front view of the new internal drive truck axle, showing drive gear and brake housings



Sectional drawing showing the operating details of the new internal-gear axle

Truck Replaces Twenty Teams

F. O SIMESON, of Limestone, Aroostook County, Maine, has a 160-acre potato farm situated 7½ miles from a railroad, yielding about 150 barrels of potatoes to the acre, or approximately 24,000 barrels. On account of a road grade between the farm and the potato storage house close by the railroad, he could haul only 20 barrels with one team of horses and make one trip a day. It would have taken him 1,200 working days with one team—just a little more than three years to haul his crop to market In order to get it to the storage house in the 60 days available between "digging and snow" it would have taken 20 teams to do the job. If Mr. Simeson and every other farmer who hauled to this particular station had found it possible to secure 20 teams for the 60 days, it would have been impossible to handle that number at the unloading station. The haulage cost alone for this number of teams would have been considerably more than $6,000. Total costs would have been enormous.

Mr. Simeson was furnished with facts and figures concerning the operating costs and given an actual demonstration of the efficiency of the motor truck by the service department of a well-known truck concern that detailed an expert to study the problem. Convinced that the analysis of his problem was correct, Mr. Simeson purchased the machine and immediately began hauling 45 barrels of potatoes to a load and making 6 trips a day. In addition to this he made frequent night hauls to get his potatoes in the storage house inside of 70 days.

At the old rate of 25 cents a barrel for 24,000 barrels, this truck more than paid for itself in the 70 days it had to do the job. Every one of the 6,000 farmers in Aroostook County is a potato farmer and every one of the 80,000 people who live there is in some way or other dependent upon the potato crop for his livelihood. They are all potato specialists, and nothing is overlooked that can in any manner improve the quality or insure the certainty of the crop. They practice the most careful cultivation, make free use of fertilizers and utilize every machine that will reduce labor and transportation costs and increase efficiency in handling the crop

Hauling the crop to market has always been a slow and tedious process. Twenty barrels make a full load and if a grower lives 10 miles from market one load a day is all he can haul. If he lives 5 miles, he is limited to two loads a day with a single team, for 20 miles is a full day's work for heavy hauling Under these conditions the growers who live at any considerable distance from a shipping point are at a distinct disadvantage. They cannot take advantage of the market.

Putting Waste Metals to Work

(Continued from page 405)

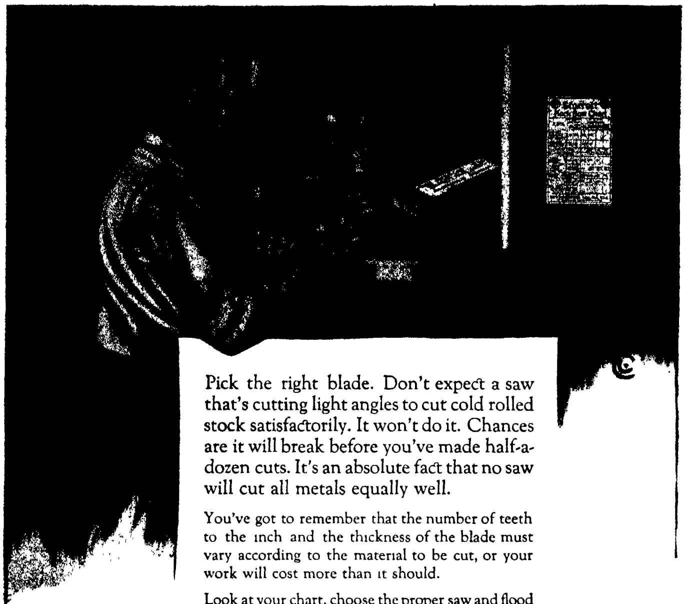
while the non-magnetic substances are swept by momentum off of the belt when it begins its downward course. Disk separators are built capable of treating from 800 to 1,200 pounds of material in the course of an hour, and the magnetic-pulley pattern of separator, according to size, is able to take care, in the same interval, of from 550 pounds up to nearly 40 tons of waste. Apart from doing what is quite impracticable by manual labor, these separators recover values that otherwise would probably be lost. Magnetic pulley separators are extensively employed now in withdrawing iron and steel from blast-furnace slag, when crushed, and from the sand of foundries. Indeed, magnetic separators are reclaiming ferrous metals from ashes, grindings and sweepings, and helping to add largely to our stores of these secondary metals So far, so good, but separation, in itself, does not suffice to insure the fullest re-use of the salvaged scrap

Light, loose turnings, borings, etc., when remelted in that form, entail serious losses by excessive oxidation in the furnace. These can be minimized by compacting or briqueting the material in advance Machines are built which effect this by subjecting the bulky scrap to enormous pressure, and the result is a dense mass which will undergo melting with nearly as little loss as a like weight of solid metal. This may be done either at the source of the scrap or at the nearest plant that specializes in the briqueting of such material. From there it is returned in the form of so-called ingots or briquets These can be forked, dumped, and handled without appreciable loss by abrasion, they facilitate economy in the use of crucibles because their shape and density permit a maximum weight of charge, and they promote greater output of recast metal in less time and at a lower cost for fuel One establishment has a briqueting equipment which turns out from 16 to 20 briquets of steel turnings per minute and these run from 12 to 20 pounds each. The light steel for these briquets is bought at the market price for such scrap and, after compacting, is sold at a premium above the market price for so-called heavy-melting steel

That the Government set an example in economy is evidenced by what was done at the U S. Naval Gun Factory where, during three years' work, it was found that manganese bronze, previously supposed to be an exacting composition, could be made without resorting to high-grade virgin metals The alloy was produced in a reverberatory furnace from materials of low grade, such as yellow brass, machine-shop turnings, zinc dross from galvanizing pots, aluminum turnings, old zinc scrap, foundry-floor scrap and skimmings, and scrap copper. Similarly, the Navy Yard proved that open-hearth steel could be made from cheap unsalable scrap, and that a considerable saving could thus be achieved over the ordinary practice of utilizing practically all heavy and high-priced melting stock

The use of lead batteries has expanded greatly through the development of the automotive industry and a large part of our secondary lead is obtained from old batteries. In 1919 the secondary lead recovered from various sources amounted to 122,100 tons. Considerable impure and low-grade lead scrap is now manufactured into toys here which previously came from abroad. Two years back the secondary tin salvaged was equal to about 42 per cent of the tin imported; it totaled 24,088 tons, and was valued at $29,868,200 Some of this was got from clean tin-plate scrap and about 400 tons was recovered from scrap tin, clippings, old tin pipe, tin foil, and collapsible tubes. Nearly all clean tin scrap is detinned by one of three processes—the electrolytic alkali, the chlorine, or the alkali saltpeter. By the

(Continued on page 417)



Pick the right blade. Don't expect a saw that's cutting light angles to cut cold rolled stock satisfactorily. It won't do it. Chances are it will break before you've made half-a-dozen cuts. It's an absolute fact that no saw will cut all metals equally well.

You've got to remember that the number of teeth to the inch and the thickness of the blade must vary according to the material to be cut, or your work will cost more than it should.

Look at your chart, choose the proper saw and flood the job with compound. Increase the pressure as the work progresses and you won't lose time or temper because the saw's not right.

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The Effect of Weight or Pressure

The demonstrated advantage that has resulted through the establishment of specific cutting speeds and feeds as most economical in the case of the lathe tool, points to the necessity of likewise determining the best working conditions for efficient Hack Saw work, as regards speed, pressure and lubrication for each type of saw and class of material.

The most vital variable under ready control is the pressure upon the saw,—which, other things being equal, determines the rate of cutting and the endurance of the blade. The proper weight to be applied on starting the cut, and when and how much it should be increased, varies with different makes of saws, and in the absence of recommendation by their makers can be estimated only by trial and by comparison of results.

The effect of pressure on the life of the saw and how it affects cutting costs is very clearly shown in the succeeding tables and curves. From all of these, it will be at once evident that too light a pressure will allow the saw to slide and wear without doing effective cutting This may show long life in hours, but also requires long periods per cut, and results in an ultimate low efficiency On the other hand, excessive pressure is unnecessarily destructive The saw may cut much faster while it lasts, but it doesn't last long enough to justify the practice. Between these extremes lies the happy mean which represents the acme of Hack Saw economy. —From Hack Saws and Their Use, published by The L. S. Starrett Co., Athol, Mass., for free distribution.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

METHOD OF FIREPROOFING AIRCRAFT PARTS.—F R Bradley, 28 Chelsea Place, East Orange, N J The invention relates to fireproofing, and has for its object to provide a fireproof sheet between the first and second fabrics of an aircraft frame, and means for supporting the second fabric at a sufficient distance from the first fabric to provide air space between the fireproof sheet and the fabrics and thereby prevent carbonisation should gasolene burn on the outer fabric

Pertaining to Apparel

COMBINED SKIRT AND SPORTING TROUSERS.—N. J Tjaeransen, Konsul Jensens, Gate 906, Christiansund, Norway The invention is particularly distinguished by the arrangement of two different rows of buttons in order to obtain a good fit when the suit is to be used as trousers or when used as a skirt. Moreover there is arranged a quite short inner pair of drawers attached to the waist band providing a closure for the upper part of the garment

HOSE SUPPORTER.—F D Graves, 70 Church St, Owego, N Y This invention relates particularly to a form of button carrying backing plate and a method of securing the tape of a hose supporter within the backing plate A still further object is to provide a device which will be practical and durable in use, resulting in a saving of tape, and a supporter in which the tape may be readily threaded

COLLAR FASTENER.—S L Gedney, 33 Clinton Ave, Maplewood, N J This inventor has been granted two patents of a similar nature, the first relating more particularly to a pin to be positioned through a soft collar to hold the outer flaps or wings in neat and proper position, the second providing a collar fastener in the form of clamps which can be readily attached to the flaps of the collar to prevent accidental movement either vertical or longitudinal the clamp devices may be readily attached and fastened together by a snap ring in the center, or by a permanent bar

HOSE SUPPORTER.—Belle C Harriss, Pelham Rd and Locust Ave, New Rochelle, N Y The object of this invention is to provide a hose support more especially designed for holding up women's hose without danger of tearing the hose, at the same time insuring a proper fit particularly across the knee Another object is to hold the upper portion of the hose circumferentially to the wearer's leg, thus relieving the hose of strain yet enabling the wearer to freely exercise the limbs without tearing the hose A further object is to hold the wearer's corset down to produce the desired straight front effect

SHAWL COAT.—L Kateman 325 5th Ave New York N Y The prime object is to provide a neat and stylish appearing as well as comfortable garment in the nature of a coat so fashioned as to be made from a single rectangular piece of material and with practically no waste parts Another object is to provide means whereby two coats may be fashioned from a single piece of material such as a shawl, blanket or steamer rug

Electrical Devices

FUSE PLUG.—J Wulf, 1127 Nostrand Ave, Brooklyn, N Y An object of the invention is to provide a simple and durable fuse plug for use with electric circuits which comprises a body having spaced terminals and a fuse connecting the terminals the body providing a receptacle for a spare fuse, which is normally separated from the live fuse A further object is to provide a fuse plug in which soldered connections are avoided and in which the fuse is visible at all times

BURGLAR AND FIRE ALARM.—Le Roy S Foltz, Fort Collins, Colo Among the objects of the invention is to provide a burglar and fire alarm which is in the nature of an attachment to the ordinary telephone system being so arranged as to apprise the central office or a neighbor's house of the presence of an intruder without the knowledge of the intruder or the presence of a fire The device includes an automatically operating receiver hook elevator with a contact making device for sending the signals over the telephone line

ELECTRIC FUSE.—R J. Kingsley, 2582 Parkside Drive, Baltimore, Md. The primary object of the invention is to provide a plurality of auxiliary fusible elements which may be conveniently brought into use either selectively or collectively to take the place of a destroyed fusible element A further object is to so arrange the auxiliary fusible elements that they may be connected in parallel with the normally active fusible elements and thus accommodate a current of high amperage

Of Interest to Farmers

GRAIN SHEAF SHOCKER.—J. P Hiebert, Box 741, Hillsboro, Kan. The foremost object of this invention is to provide a comparatively simple sheaf-shocking mechanism to be used in conjunction with any ordinary reaper, all of the functions of the mechanism being automatically performed, with the exception of the final shock discharging operation, which is manually performed Another object is to provide a shock-forming mechanism in which the various operations of handling the sheaves in the course of forming a shock are automatically controlled and accomplished by the individual sheaves themselves

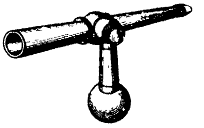
MOWER GUARD.—J. R Edgar, Ava, Ill The object of the invention is to provide a construction of guard finger having integral upper and lower portions secured to opposite sides of the mower bar and exerting pressure or tension upon the cutter bar and cutters to insure a perfect engagement between the cutter blades and the stationary blades or shear plates of the fingers A further object is to provide a construction of guard finger which can be used on any ordinary mower bar

OBSTETRICAL TABLE.—P C Juhl, R F D Princes Bay, S I, N Y The object of the invention is to provide an obstetrical table especially designed to support a cow horse, or other animal in proper position on its side to enable a veterinary surgeon or other person to conveniently operate on such animal, particularly in case the fetus is in abnormal position, and to prevent the animal from pressing against the operator

BACKBAND.—J B McHugh, P O Box 16, Zachary, La Among the objects of the invention is to provide a backband for draft animals which will be comfortable to wear and which will be readily adjustable to animals of different sizes A further object is to provide means for securing the trace chains to the backband and to provide a backband which will be strong and durable

Of General Interest

HOLDER FOR CIGARS AND CIGARETTES.—P F Pineda, Barquisimeto, Estado Lara, Venezuela The invention relates to a sanitary holder, the general object being to avoid the bad effects of the nicotine on the smoker, this object is attained by providing a holder in the form of a stem comprising a mouthpiece and a receiver for the cigar or cigarette, together with means between the receiver and the mouthpiece a water container or smoke washer through which the smoke is caused to pass for eliminating the nicotine and cooling the smoke

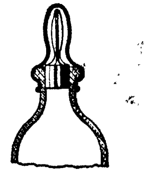


A PERSPECTIVE VIEW OF THE INVENTION

IDENTIFICATION DEVICE.—H J W Morgenthaler, address G Burchard Smith, 55 Liberty St, New York, N Y The invention relates more particularly to devices for identifying babies in hospitals and the like A further object is to provide an identification device which can be readily assembled to indicate the name of the child, and which can be quickly and easily positioned around the neck or arm of the child and sealed so as to prevent possibility of mistake

COMPOSITION FOR WALL BOARD.—E D Martinet, 5922 Towne Ave, Los Angeles, Cal The invention has for its object to provide a composition especially adapted for use in the preparation of composition board. The composition is composed of ordinary building plaster, saw dust, extract of cactus juice and heavy black molasses. This composition forms a board which is sufficiently rigid, yet flexible and elastic, and will permit a nail to be driven through the same and will hold the nail so that it does not pull out easily

ATTACHMENT FOR NURSING BOTTLES.—A. Gerstner, 10428 90th Ave., Richmond Hill, L I, N. Y. This invention comprises a novel device for use in connection with nursing bottles, it is made of semi-vulcanized rubber to be inserted within the nipple, the plug member having grooves in its sides to limit the flow of liquid, the head member having wings to prevent collapsing of the nipple, this device being removable it can easily be cleaned which is the main point, making it sanitary



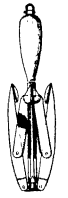
A SECTION OF BOTTLE WITH ATTACHMENT APPLIED

ATTACHMENT FOR PENCILS OR THE LIKE.—A A Beck, c/o Lake Julian Sanitorium, Puposky, Minn One of the principal objects of the invention is to provide an attachment for attaching an eraser to a pencil which permits not only of the feeding of the eraser as desired, but also allows the insertion of a new eraser when the original one is worn out, and which also functions as a clip for retaining a pencil in the pocket of the user

BEDCLOTHES HOLDER.—E T Edlund, c/o A Erickson, 159 Christie St, New York, N Y The invention relates more particularly to children's beds, to prevent the clothing being accidentally displaced. The general object is to provide a device to be disposed across the bed at the foot providing means for engaging the bed clothes at their lower edges, and means by which they may be quickly clamped or unclamped in connection with the mattress

STERILIZED ATTACHMENT.—P P Pupilla Bradley Beach N J The invention relates to a shaving brush sterilizer which may readily form an attachment to a conventional sterilizer utilized in modern barber shops, and which shall be so extremely simple as to present virtually no outlay of capital in addition to the purchasing of the conventional sterilizer and by means of which a brush may be rapidly sterilized, so that practically no loss of time is experienced in operating the same

ANCHOR.—E Goodreau, Box 968, Cordova, Territory of Alaska This invention has for its object to provide an anchor having a stem and flukes pivoted thereto and arranged to fold in substantial parallelism with the stem, or in positions radial thereto, and having means for locking the flukes in expanded position; the arrangement is such that the flukes open of their own weight. The anchor is especially designed for use on motor boats.



A SIDE VIEW CLOSED, WITH PARTS IN SECTION

Hardware and Tools

GUN CLEANER.—A. C. Drummond, 86 Prospect Ave., Ilion, N. Y. The object of the invention is to provide a cleaning tool for cleaning the barrels of shotguns, rifles, or revolvers, and which is provided with an arrangement of spiral cleaning blades which are capable of adjustment to correspond to the bore of the barrel to be cleaned.

KNIFE.—E. Bom, c/o H. B. Tempering Process Co., Clearbrook, Minn. The invention has particular reference to pocket or so-called pen knives in which the cutting blade or blades are adapted to assume an open or closed position relative to the handle in which they are mounted. The primary object is to do away with the customary spring and provide means for locking the blade or blades in either an open or closed position

NUT LOCK.—C R. Cochran, Box 373, Vale, Oregon. This invention has for its object to provide a lock which may be positively locked upon the bolt to prevent turning off of the lock, the lock having teeth at a predetermined point normally extending inwardly beyond the apex of the thread to positively engage the bolt, and adapted to be withdrawn beyond the apex of the thread by bending that portion of the lock to which the teeth are connected obliquely

PIPE CUTTER.—M J. Caffrey, 319 W 126th St., New York, N. Y. The object of the invention is to provide a pipe cutter arranged to permit of cutting a pipe without requiring the use of a vise or other separate means for holding or gripping the pipe while cutting the same Another object is to permit accurate cutting of pipes of different diameters without requiring much physical exertion. The device is portable, simple, of few parts, and not liable to get easily out of order.

LOCK.—J J. T Rodey, 990 Jefferson Ave., Brooklyn, N Y The invention relates to certain improvements in connection with what is generally known as the "Segal lock" with a view to rendering the lock immune from breakage and disarrangement due to the door to which it is applied being slammed A further object is to render an unauthorised opening of the lock practically impossible except by a duplicate key

SWING HANGER.—A J. Nuss, 706 Louisa St, Williamsport, Pa An object of the invention is to provide a self-lubricating hanger which will overcome the annoyance of squeaking porch swings and similar devices. A further object is to provide a hanger and hanger mounting which is noiseless and at the same time strong and durable in use, and which will be cheap to manufacture.

Heating and Lighting

RETORT.—H. M Barr, Box 1070, Pensacola, Fla The object of the invention is to produce a retort in such form that the high degree of heat required to successfully operate and efficiently carry out the process of distillation may be attained without the employment of cumbersome and unyielding jackets of brickwork, concrete or other masonry, thereby eliminating the damaging effects due to ruptures or cracks that occur in the masonry.

GAS STOVE.—M. Cohen, 81 Union Sq, New York, N Y. The general object of the invention is to provide a gas stove designed for use as a cook stove and more particularly with a view to increasing the usefulness of the stove in such culinary work as is generally included in baking, broiling, frying and the heating of water

GAS HEATER.—H. B. Dallimore, 218 Logan St., Brooklyn, N Y. This invention relates more particularly to a gas heater adapted to be quickly and easily positioned in the fire box of an ordinary coal range, an object being to provide a heater of the character stated which will function as a heater for the water back as well as the oven and stove top to permit the use of the range for all ordinary purposes dispensing with the necessity for using coal.

Machines and Mechanical Devices

ADJUSTABLE BUSHING.—H. M. Closs and H. G. Taylor, 21 S. Jefferson St., Webb City, Mo. The object of the invention is to provide a bushing especially adapted for use with bolsters, and which is capable of adjustment from the inside of the drum. The bushing is split in halves, that is to say, is sec-

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Putting Waste Metals to Work

(*Continued from page 415*)

first method the tin is reclaimed in the form of a spongy granulated precipitate, which can be remelted into pig tin; by the second, tetrachloride of tin is recovered for use in the weighting and the dyeing of silk; and by the third procedure the tin is secured as an oxide, which is employed as a coloring agent in the enamel industry or melted into pig tin by means of a reverberatory furnace.

Aluminum chips from castings produced in the making of automobiles have become a large source of secondary aluminum. By the old treatment the loss in remelting such chips was sometimes as high as 40 per cent, but government experiments revealed awhile back that it was quite practicable to lower this loss to as little as 10 per cent. The secondary aluminum, in the shape of pig aluminum or in alloys, totaled a matter of 18,691 short tons in 1919, and was valued at $12,014,600. Various products are made by smelters and refiners from scrap aluminum. During the same year we obtained 2,447 short tons of secondary nickel worth $1,829,400 Of the resultant refined nickel, about 60 per cent is used in nickel steel, 30 per cent in white-metal alloys, 5 per cent in anodes for plating, and 5 per cent for miscellaneous purposes, including the manufacture of salts and other chemical compounds As has been well said, "By depriving the market of any useful scrap metal the price of virgin metal is driven up proportionately."

Finally, in sketching the potential savings through the recovery of secondary metals, let it be said that blast-furnace flue dust, which is so often neglected, has an iron content of more than 40 per cent. By briqueting this dust it can be fed back to the furnace and much of the valuable iron in it can be melted and cast into marketable pigs The recent perfecting of machinery for briqueting this material opens up channels to tremendous economies. Our large industrial enterprises are profiting by the lessons learned during the late conflict, but the thing needful is to impress upon their smaller brethren that they, too, ought to adopt the same practices so that the nation as a whole may be the better fitted to cope with the foreign producer.

The Truth About the Dye Industry

(*Continued from page 408*)

for the production of essential pharmaceuticals Some of the most necessary drugs for the maintenance of public health are produced from coal-tar products. I will mention only such things as salvarsan, aspirin, novocain and phenacetin.

Prior to 1914 we were entirely dependent upon Germany for these products; today, physicians and dentists will tell you that they are difficult to obtain, and are very expensive. They have not yet been produced adequately by the American dyestuff manufacturer, but given a fair field this is the next step of development which, already in preparation, is bound to come. Is it not advisable that an industry which can yield such substances for the relief and benefit of the human race should be maintained?

Again, we are reaching a point where in many sections of our country, the soil has become exhausted and requires replenishment with those necessary chemical ingredients which enable it to yield its full percentage of crops. These chemicals again come from the collateral chemical lines intimately connected with the coal-tar chemical industry, such as the products of nitrogen from the air, which make possible the necessary nitrates and the manufacture of ammonia, as well as other chemical factors which are indispensable to the proper preservation of land values.

Finally, the preservation of the coal-tar chemical industry is indissolubly associated with the national welfare, in that it is from this industry that the high explosives and poison gases are obtained which have made modern warfare what we realized it to be in 1917-1918.

The country which has a well-established coal-tar chemical industry, is the country which is ready to meet an aggressive attack almost at a moment's notice. The same plants which produce coal-tar colors can be changed and diverted into the manufacture of poison gases and high explosives with the least possible margin of delay—to use a slight literary exaggeration, almost over-night

For instance, there is a black dye, sulfur black, very extensively used for dyeing our black cotton stockings In its finished state, it is simply a harmless, grayish-black powder If the process of its manufacture however had been stopped before the last step was completed, and had been switched off in another direction, we should have produced picric acid, one of the most powerful explosives known.

Again, a certain brilliant yellow dye, made from coal tar, and in universal use for obtaining delicate golden tints, if also stopped before the completion of the final step, produces one of the most deadly forms of poison gas, a gas which renders modern rifle fire and the machine gun ineffective and useless to the same degree as the high-powered bullet threw into the discard the shoulder-to-shoulder formations and solid squares of the days of Waterloo

There is a story which may be apocryphal, that prior to 1914 one of the largest German dyestuff manufacturers was making, under instructions from Berlin, large quantities of di-nitrotoluol There was no particular market for this product, and they simply continued its manufacture, piling up huge quantities without any apparent outlet for it When the war broke suddenly upon the world in 1914, instruction came from Berlin to add one part of nitric acid to this di nitrotoluol and it was immediately converted into tri-nitrotoluol—TNT

With this TNT Germany battered down the walls of Liege and Antwerp and blasted her way through Belgium and northern France, while the Allies were still under the delusion that they could hold back her gray hordes by peppering them with shrapnel.

Some weeks ago a squadron of airplanes flew over the lower part of New York They were a beautiful sight, and the surging crowds filling the streets at the noon hour watched them with admiration and interest In their passage over the business district, they dropped smoke bombs and marked the places where they struck The layman cannot easily imagine what would have happened if these had been bombs filled with TNT and poison gas, but the expert knows Theoretically, these planes destroyed the whole lower part of New York and its dense day-time population in fifteen minutes. And this destruction would have been caused by products obtained from the coal-tar chemical industry

Do we want to see this country placed in a position where such a thing as this might easily happen; where from the decks of a line of mother ships anchored twenty miles off shore, such a squadron might have been sent to cause this destruction without any possibility of defense? The world is sick of war, but is there anyone who is so optimistic as to believe that war has been finally abolished? As long as human ambition leads individuals to seek the glory that comes from triumphant war, as long as the surging yellow and brown hordes of over populated countries are seeking outlets for their millions who are starving to death on their own resources; as long as the industry and commerce of a nation develop beyond the point where its products can be absorbed by the home mar-

(*Continued on page 419*)

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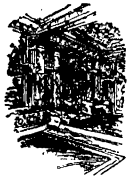

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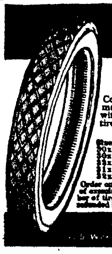

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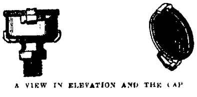
RECENTLY PATENTED INVENTIONS

(*Continued from page 416*)

tional so that it may be applied or removed without taking the drum from the shaft A door is provided giving access to the interior of the drum.

GREASE CUP —D E Hardman, Simms, Mont A purpose of this invention is to provide a grease cup in which there are no screw-threaded portions *to be removed when refilling* the cup, thereby eliminating the remeshing of the threads when closing the cup A further purpose is to provide a cup which is quickly and easily removed, and means for automatically locking the same against accidental displacement


A VIEW IN ELEVATION AND THE CAP

MERCERIZING MACHINE.—J Spitzer, 425 Hill St, W Hoboken, N J. This invention relates to apparatus for mercerizing cotton yarn by the use of caustic soda or similar mercerizing solutions The object is to provide a machine arranged to effectively and economically mercerize a large amount of yarn at each operation, and in a comparatively short time, the machine being continuous and automatic in operation and not requiring the services of highly skilled labor.

BUFFING OR POLISHING WHEEL —A Levett, 125 W 12th St, New York, N Y The object of the invention is to provide a polishing device arranged to combine with the body of the wheel a polishing compound without requiring the workman to periodically apply the compound to the peripheral face of the wheel Another object is to leave the work exceedingly bright and clean without any particles of the polishing compound adhering to *the crevices, filigree or other ornamentations* on the article being polished

SHUTTLE MOVER —F J Baume, 42 Primer Place, Avenida, Wruguay, Mexico City, Mex This invention aims to do away with the usual means actually in engagement with the shuttle for moving the same and to bring about advantages not only in construction of looms but *in construction of shuttles*, by the application of shuttle moving means which will effect the desired results as far as movement is concerned without actually engaging the shuttle

PAPER FEEDING APPARATUS FOR TYPEWRITERS —W C Avery, 2820 Vancouver Highway, Honolulu, Territory of Hawaii It is a purpose of the invention to provide a paper feeding apparatus and mechanism including trays for supporting the paper, such trays being balanced to coact with feed rollers to effect a simultaneous feeding of a plurality of sheets of paper in such manner that the sheets will occupy corresponding positions on the platen of a typewriter

PERFORATING AND CUTTING DEVICE FOR MULTIGRAPHS —W T Collins, decd W. DeMilly, Box 445 Tallahassee, Fla The invention relates to a device which is in the *form of an attachment so that it may be ap*plied to a multigraph machine of ordinary construction for perforating and cutting the paper as it leaves the machine It is a purpose to provide an attachment in which the cutting and perforating blades are associated with supporting disks to permit of the removal and substitution of other disks when they become worn or broken.

SECTIONAL CABLE FOR HANDLING LOGS —W. H Peters, 1878 Tabor Court, Portland, Ore This invention relates to devices for use in logging and has for its object the provision of a cable formed in sections which are flexibly connected by clevises to which may be secured chains connected with logs whereby the logs may be properly handled at all times and especially while they are descending an incline

Musical Devices

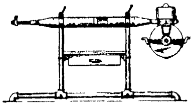
CONTROLLING DEVICE FOR PHONOGRAPHS.—E O Breuning, 58 8th St, Hoboken, N J. The principal object of this invention is to provide a device in the nature of an attachment for phonographs which is designed to actuate the phonograph at a predetermined time Another object is to provide time controlled mechanism for actuating *the turn table of a phonograph prior to the* presentation of the needle in contact with the record, the device will also automatically stop the phonograph A further object is to provide a controlling mechanism which is applicable to clocks of various standard types.

TONE FOOT FOR PHONOGRAPHS —W H Prickett, 46 Yard Ave, Trenton, N. J, P. O. Box, 299 The invention relates to feet for use beneath the legs of phonographs and has for its general object to provide a foot, the use of which will result in a clearer and more distinctive reproduction of the record, with a smooth and full tone and in a manner to preserve the characteristics and beauty of the original production

DISK RECORD —H W Meyer, 5412 Greenwood Ave, Chicago, Ill This invention relates to disk records for phonographs An object is to eliminate the trouble so often experienced *in locating the beginning of the rec*ord groove, by providing a locating or guide groove which is of such size that it can be readily seen and in which the needles will automatically find its way to the record grooves

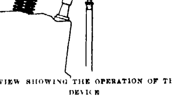
Prime Movers and Their Accessories

STAND FOR FORD ENGINES —C C Price and D V. Bridwell, Dumas, Ark A purpose of the invention is to provide a simple and compact stand which is designed to support two engines of the Ford type in such manner that the overhauling and disassembling of one engine can be carried on without interfering with the disassembling of the other A further purpose is to provide a stand which is *adjustable to varying positions so as to render* any part of either engine accessible


A SIDE ELEVATION OF THE DEVICE WITH ONE ENGINE IN POSITION

ENGINE PISTON —J W Calta, Platte, S D The invention relates to pistons and cylinders of internal combustion engines An object is to provide a piston having means for preventing the working of the oil up into the explosion chamber, said means comprising *a plurality of recesses forming pockets* which may contain a sealing compound

PUSH ROD EXTRACTOR —R F Bailey and R. T Hoopingarner, address S N Edgman, Box 71, Holly, Colo *Among the objects* of the invention is to provide tools for compressing the valve operating spring on internal combustion engines and particularly on that type of internal combustion engine employing valves of the overhead or valve in-head type, to facilitate the removal of the push rod therefrom


A VIEW SHOWING THE OPERATION OF THE DEVICE

INTERNAL COMBUSTION ENGINE —N T Collins, 707 8th St, Sacramento, Cal An object of this invention is to provide means for holding the compression of the gas mixture in the combustion chamber at the desired pressure while the engine passes over top center A further object is to provide an auxiliary cylinder and piston, said cylinder communicating with the main cylinder of the engine and the piston of the auxiliary cylinder controlled by the crank shaft through the medium of operating means so as to hold the compression for efficient results

CARBON REMOVER —R. R. Champlin, R F D No 1, Manchester, N. H The invention relates to a composition for removing carbon from internal combustion engines, and which in operation will not injure any part of the engine or mechanism with which it comes in contact, and a further object is to provide a composition which may be cheaply made comprising *denatured alcohol, benzine, kerosene,* water, camphor, sodium hydroxid and sodium carbonate

HEATING APPARATUS FOR INTERNAL COMBUSTION MOTORS.—H. J. [illegible], 22B Rue Vallier Levallois-Perret Seine France In internal combustion motors using heavy oils which are not volatile at ordinary temperatures, it is necessary *to employ a* suitable apparatus for the purpose of effecting a complete vaporization of such liquids before admitting them to the cylinder. The present invention has for its object to provide a supplementary arrangement for heating by means of a branch off the exhaust. The invention also automatically regulates the amount of exhaust gas employed for effecting the supplementary heating by means of controlling the admission of the gas into the cylinder.

Railways and Their Accessories

DRAFT APPLIANCE FOR LOCOMOTIVES. —G J Hubstis, c/o Canadian Customs, Belleville, Ontario, Canada The principal object is to provide means for controlling the discharge of steam from the exhaust nozzle in the smoke box by the provision of an attachment for the exhaust nozzle which will permit the steam to be deflected through opposite sides of the center *or allow the draft to go straight* up through the stack in accordance with the desire of the engineer

Pertaining to Recreation

GAME —N D Dillon, 621 1st Ave. West, Seattle, Wash The invention relates to a card game While it is primarily intended for the amusement of the participants at the same time it serves as what is commonly known as a psychological test, in that it brings to the surface all of the perception and reaction and causes the player to make quick decisions

WHIRLING TOP —J T Edson, Sailors Snug Harbor, New Brighton, S I, N Y The particular object of the invention is to provide a toy involving the use of weighted cords adapted to be caused to whirl simultaneously in substantially the same plane but in opposite directions, having the characteristic of exciting the interest of any observer who may not be familiar with the physical principals involved and so rendering the toy of an attractive nature.

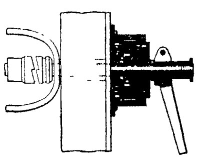
GAME —V Dickerson, c/o G C. Cowley, Station T, New York, N. Y. The invention relates to that class of device in which pellets of desired construction are utilized in connection with what might be termed a maze, a central inclosure being associated with such maze into which the pellets are to be guided by tilting the supporting means for the maze, but without the assistance of the hands in direct contact with the pellets

Pertaining to Vehicles

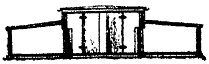
LOCKING DEVICE —D E Weeks, 137 Farragut Ave, Olympia, Wash An object of the invention is to provide a simple, rugged, effective and easily attachable device, capable of attachment to certain parts of an automobile, particularly to the segment on the steering wheel with which the gas and spark levers are connected, and one which when once locked on the machine cannot be taken apart or tampered with except by the person having the proper key

ALINEMENT DEVICE FOR AUTOMOBILES —C S Peets, 250 W 54th St, New York, N Y The invention relates to automobiles of the Ford type, and its object is to provide an alinement device arranged to reduce sidewise swaying of the car body to a minimum Another object is to readily permit *of applying the device without* requiring changes in the construction thereof.

STARTING CRANK FOR MOTORS —F. F. Redding, 8932 89th St, Woodhaven, L I., N Y. *The primary object* of the invention is to provide a starting mechanism of the hand cranking type for internal combustion engines commonly employed in motor vehicles, and more particularly to engines used in trucks. It is a further object to provide means for preventing a movement of the starting crank in the reverse direction, which sometimes *occurs owing to a premature expansion* in the motor cylinders.

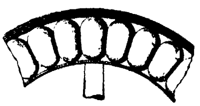

A HORIZONTAL SECTIONAL VIEW WITH A PORTION SHOWN IN PLAN

GARAGE STRUCTURE.—G. A. Shaul, Seneca, Kan. The purpose of the invention is to *provide structure of simple* and fireproof construction, and which will form a plurality of garages for the individual housing of automobiles A further object is to provide a garage having a common driveway and a roof disposed above the roof of the individual lockers or garages, the walls connecting the roof of the driveway with the roof of the lockers being formed with windows to allow the transmission of sunlight and air.


A TRANSVERSE SECTIONAL VIEW, SHOWING DRIVEWAY AND GARAGES

AUTOMOBILE SIGNAL.—E. Hebbeln, 1628 W. 16th St, Davenport, Iowa. This invention has reference to automobile signals designed to replace the custom of extending one's arm and hand from the side of a car to indicate when a turn is to be made, and thus avoiding collisions and accidents The device relates to a signal visible in day or night, and especially adapted for foggy weather, being discernible at a considerable distance The signal is conveniently operated from the driver's seat.

RESILIENT TUBELESS TIRE.—A H. Young, 1123 12th Ave., Oakland, Cal The particular object of the invention is to provide a tire construction which will avoid the usual disadvantages with respect to blow-outs, punctures and the like requiring replacement and repair of an inner tube when it is once perforated The invention also has for its object the provision of a non-deflatable tire adapted alike to wheels of different vehicles employing pneumatic tires at the present time


PARTIAL LONGITUDINAL SECTION OF THE TIRE

REAR AXLE DRIVE FOR MOTOR VEHICLES —O. S Pulliam, Room 2528, Park Row Bldg, New York, N. Y The primary object of this invention is to provide a device which is adapted to take the place of the ordinary differential commonly employed A further object is to provide means by which differential movement of the driving wheels of a motor vehicle is obtained, at the same time provision is made for positively locking both the wheels with the power transmitting element

SELF-PROPELLING CRANE —G. Brun, 1 Rue Jules Lafebvre, Paris, France. This invention has for its object to provide a self-propelling traveling crane so constructed that the motor that propells the vehicle shall likewise be capable of being utilized for operating the crane, that is to say, to slue the crane around on its own axis and to wind up the lifting rope.

BICYCLE —O J Hennebaul, 223 E. 122nd St., New York, N. Y This invention relates to a bicycle which is especially adapted for use by boys, and has for its object to provide a bicycle of simple and inexpensive construction so that said bicycle may be produced at a minimum cost The steering head, braces, handle bars, wheels and saddle all being made of wood, the balance of metal to give added strength.

Designs

DESIGN FOR A SPOON-KNIFE.—I. Rupp, Gaston, Ore

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The Truth About the Dye Industry

(Continued from page 417)

kets, and where foreign outlets must be sought, there will be the possibility of war The next war will be a chemical war, and the nation which has safeguarded its chemical industry and has enabled it to become self-sustaining and independent of foreign contributions will be the nation which, because it is prepared, will be the most free from foreign aggression

The new hope of mankind is embodied in the word "disarmament." Armies are to be reduced to a minimum; the building of forty million dollar battleships is to be abandoned, obsolete war vessels are to be scrapped, and war planes, capable only of being used for offensive purposes, are to be no longer built—but no nation can afford to disarm and to make itself defenseless against attack, unless it has an industry from which, with the least possible loss of time, indispensable trained chemists may be obtained, and products which are the basis of munitions of war secured for its defense.

That is what the coal-tar chemical industry means to us When we hear that our Congress has been asked to pass that legislation which will enable it to protect itself for a few years longer against threatened foreign competition, even now being prepared by a nation which is determined to regain its military and industrial control of the world, and based on cheap labor costs and depreciated currencies, it is to be hoped that each one of us will lend his individual influence wherever it may be applied, to seeing that this protection is afforded, not for the purpose of building up a money-making monopoly, or even for giving one branch of industry *especial* consideration, but that we may be maintained in the guaranteed security of our own interests and in the peaceful possession of our own homes.

The Giant of the Skies

(Continued from page 409)

bly never can be put to a precise and thorough test, and which in addition to the doubt thus thrown upon their results, admittedly are a matter of probabilities only, so that in the cases of individual stars they may give us results that are far from the truth In spite of these drawbacks, there are ways of checking up in a general way the determinations of distance thus obtained, so the astronomer feels safe in stating that Betelguese is more than 250 and less than 300 light years from our own system

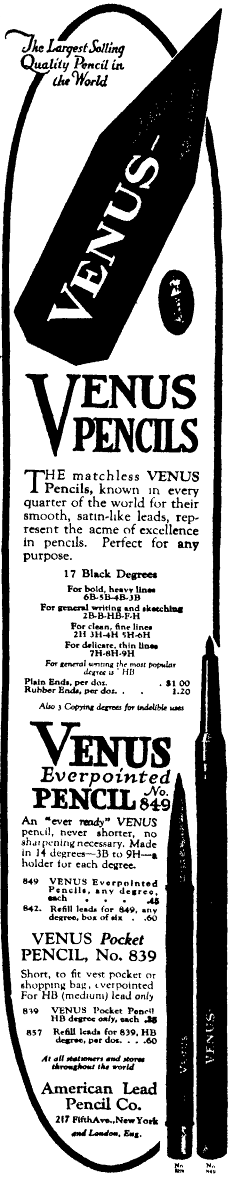
A light-year is of course the distance traveled by light in a year If we feel that we must have it in terms of a more familiar unit, we can convert the light-year into miles by the simple process of multiplying together the numbers 186 000 (miles per second for the velocity of light), 60 (seconds in a minute), another 60 (minutes in an hour), 24 (hours in a day), and 365 (days in a year). If we do this and express the result in the round numbers which alone possess significance in dealing with such magnitudes as these, we find the light-year to be the equivalent of some 5,800,000,000,000 miles—or better yet, six trillion miles Betelguese, then, in spite of his prodigious size, is so far away from us—close on the number of miles measured by a 2, followed by 15 ciphers—that he still appears to us, not alone with the *naked eye* but equally in the most powerful telescope, to be but a geometric point of light without any magnitude We should like to drag this distance of 300 light-years into our graphic *comparison in some way*, but we don't know how it is to be done With the trivial expanse of 300 million miles we feel that we have had some success in seeking a pictorial representation, when it comes to two quadrillion miles—well, there isn't much hope We really believe the most adequate way to convey an idea of this is to state the velocity of light in miles per second, with the number of years it takes it to reach us from Betelguese at this speed

Then, lest the reader should get the feeling that this must be about the limit, and that he has surely plumbed the depths of space, we may throw in gratuitously the remark that the distance of 200,000 light-years is stated with reasonable accuracy in connection with the most remote *visible objects* whose distance has as yet yielded to analysis, and that Dr Einstein finds this figure far too small for his finite unbounded universe, putting the extent of this at some 200,000,000 light years—no, not miles or astronomical units of 93 million miles each, but *light-years* After this we shall presumably be convinced that the juggling of long strings of zeros neatly done up by means of commas into packages of three has gone about far enough The difference between an infinite universe on the old Euclidean plan, and a pseudo-Euclidean framework of a mere 1,000,000,000,000,000,000,000 miles, is not large enough to cause any of us to pass sleepless nights In the event that our enthusiasm for large mouthfuls of digits is not yet satiated, however, we might set to work estimating how many electrons, of some 000,000,000,000,000,025 *inch* diameter each, could be accommodated, at a pinch, in this finite universe It's a small matter, but just as a formality we remind the person who undertakes this not to overlook the fact that there are 63,360 inches to a mile

Einstein's Theories of Relativity and Gravitation

(Continued from page 409)

Mr Bolton's rather unadorned statement of the postulates and the consequences is admirably supplemented by the essay from Mr Francis, of New York, which frankly devotes practically all its space to a discussion going to show by means of brilliant analogies just why and how the concepts of space and time have to be modified, and how this modification can lead to a new theory of gravitation Commander McHardy, of London contributes an essay of somewhat similar scope, but written with less attention to analogy and more to technical detail regarding the nature of the world under the new concepts Mr Hugh Elliot, of Chiselhurst, Kent, is selected as the essayist who to quote the preface, "has come closest to really explaining relativity in terms familiar to everybody, without asking the reader to enlarge his vocabulary and with a minimum demand so far as enlarging his mental outlook is concerned" Dr de Sitter, the eminent Dutch astronomer, contributes an essay which is of value in showing how the General Theory may be made to stand on its own feet and developed independently of the Special Theory something which we believe many lay readers had not previously realized Dr E T Bell of the University of Seattle takes as his text the idea which we *first saw clearly* expressed by Eddington that Einstein's contribution to science consists in having isolated to a greater degree than ever before achieved, the contributions of the observer and of *the observed external, the external* reality is shown to be far more tenuous than we should have supposed Dr Dushman, of the Schenectady laboratories, and Mr. Hemens, of London, develop in somewhat *different fashion another central* idea of the Einstein theories—that the gravitational effect is due, not to a 'force' of some mysterious sort, but to the observer's interpretation of an inherent ge*ometrical property* of time and space Mr Davis, of the University of Wisconsin, again quoting the book (this time the chapter subhead), gives us a treatment in which the essentially mathematical characteristics of Einstein's work "are brought out more strongly and more successfully than is usual in a popular explanation" Dr Murnaghan, of Johns Hopkins, looks upon Einstein's structure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as the logical climax of modern physics, which for a long time has been engaged in what his title announces as "The Quest of the Absolute" Dr Pickering of Harvard and Jamaica, tells us exactly what the new theories mean to the physicist and the astronomer. Dr. Russell, well known to *Scientific American readers, has stated conversationally that he disagrees with those scientists who regard the General Theory as the most significant of Einstein's two productions, and he justifies his belief by contributing what every reader, lay or technical, must believe is correctly characterized by the Editor as the best discussion of the Special Theory found in any of the competing essays.* Considerable parts of the essays of Dr T Royds, of the Kodaikanal Observatory in India, Prof. W F. G. Swann, of the University of Minnesota, and Prof. E. N da C Andrade, of the British Ordnance College, furnish material of value not found elsewhere The volume is concluded by a few fragments on the General Theory that have seemed too good to lose—the corresponding material on other phases of the subject has been worked into the introductory chapters

We do not regard it as a confession of weakness when anyone admits that some of the chapters of this volume are unintelligible to him But that the care which has been taken to pave the way properly has made it possible for anybody to get out of this book a better understanding of relativity than out of any other we believe is certain Einstein himself pays far too much attention to the details of the process by which the theories developed in his mind—it may be advantageous to think them out that way in the first place, but every teacher knows that there is usually a better way to present a subject *to the beginner than the way in which* it was originally made a part of human knowledge Eddington's book is admittedly far beyond the ordinary reader Dr Slosson *we suspect would be the first to* admit if cross-examined, that he had fallen short of telling the reader the really significant things about his subject Several books which we shall not mention by name we can most charitably characterize as thoroughly mediocre. We believe we have in this volume the only book which makes a reasonable combination of completeness and intelligibility—the only one that tells anything worth while about Einstein's theories while at the same time telling the story in understandable fashion If we may not follow the footsteps of one of our enthusiastic editorial colleagues who regards the book as the last word on relativity, we feel surely entitled to refer to it as the latest and the best If there is any virtue in numbers, it ought to be—65 authors surely ought to get most of the meat out of the subject

Radio with the Arc Transmitter

(Continued from page 410)

kind of radio set and were picked up by a collector of customs and given a "temporary permit," are a thing of the past. With the increased efficiency which has been recognized for the past few months, it is thought that the number of arc installations will rapidly increase

The Air Mail Service, which is under the jurisdiction of the Second Assistant Postmaster General now maintains a series of six arc stations at landing fields in the West Communication, night or day, is carried on directly between North Platte, Neb, and Elko, Nev, which are approximately a thousand miles apart. The territory intervening is of the worst possible nature for radio communication. Messages between these two stations are copied directly on typewriters by the operators, so the intensity of the signals may well be considered as very good In this instance a few changes have been made in the apparatus, in order to make it most adaptable to the service to which it is put, while the amount of power consumed is 3 kilowatts It is doubtful that there is any such efficient communication, where the same amount of power is consumed, any place in the world.

In addition to its carrying power, arc transmission has the advantage of what is called "sharp tuning," which makes it possible for more stations to operate at a given time without interfering with each other

Several South American papers, including the Buenos Aires *Herald*, have commented at length on the work being done by the "Aeolus" It is a revelation to them and it is thought that their interest will be followed by the purchase of similar equipment from this country.

A majority of the apparatus formerly sold to South America for radio purposes was either English or German. Most of it was as good as could be procured at the time it was designed, but it is antiquated now and in deciding on replacing the old apparatus, as well as in the erection of new stations, much attention is expected to center about the arc sets.

The arc transmitter is a producer of continuous waves and these waves are much more effective in overcoming difficulties which arise from static. For this reason also, the arc will meet with favor in those countries where there is likely to be a prevailing atmospheric condition of that character

A Super-Dreadnaught as Target

(Continued from page 412)

showing clean perforations of the 12-inch belt and barbette armor of the "Seydlitz," "Derfflinger," etc., and Commander von Hase, gunnery officer of the "Derfflinger" at Jutland, has admitted in his book, "The Two White Nations," that the two after turrets of his ship were totally wrecked in succession by direct penetrations from British 15-inch projectiles which exploded after passing through the barbette armor.

Interesting as these "Baden" experiments have doubtless been, they will be surpassed in educational value by the test which is to be made this summer with the British battleship "Agamemnon." This old ship, of a type intermediate between the pre-dreadnaught and the dreadnaught, is now being equipped as a movable target under wireless control, and will be attacked by the guns of the Atlantic Fleet. The speed and course of the target will be unknown to the firing ships, and as the practice is to be at considerable range the experiment should result in valuable evidence as to the present efficiency of the British Fleet at long distance firing.

A Rocky Mountain Town Which Runs Its Own Plant

(Continued from page 413)

There was also some dissatisfaction with the local company already in the field, which naturally opposed the project vigorously when it heard the citizens talking up the subject In fact the corporation sought to enjoin the city from spending the city funds outside of the city limits when it became necessary to seek the source of power in the Rocky Mountains some 20 miles away, but this difficulty was overcome by the organization of The Longmont Service Company, a private corporation of 63 public-spirited citizens, who built the power plant, transmission line and substation and sold them to the City of Longmont at the original cost of $40,500, thereby extending their credit to their home town to that amount and taking in payment city warrants payable from 65 per cent of the net earnings of the plant.

A never-failing water supply had already been assured two years before by throwing a dam across the north fork of the St Vrain River to form a settling basin, freeing the water of silt before it was piped for domestic use, and the city built its power plant on this pipe line. The pure mountain water, fed by the melting snows, is led overland in a 30-inch concrete pipe from [illegible] the dam for 4½ miles on a water grade to a point above the power house where it enters a 20-inch steel pressure [illegible] drops 475 feet with force sufficient to generate 800 horsepower.

The consumers have the advantage of an unusually low rate, namely, two and three cents per kilowatt, based on the amount taken, from April to October and 10 cents during the winter months, November to March, each house being also allowed one porch light at night free About 1,000 meters are connected to the system and 75 families use the electric current for cooking exclusively. A household's bill will run from $2.50 to $10.00 per month according to demand for the current.

On the bookkeeping side the city seems to be coming out ahead. The investment in power house, transmission line and so on represents $10,000 which in the nine years since the current was first turned on has been fully paid for, and the city's balance sheet shows a surplus of $150,000. The gross annual revenue is about $60,000. It did not seem fair to the Water Department to ask it to stand the entire expense of impounding the water in the first place and the Electrical Department get the use of it for nothing, so it was arranged for the Electrical Department to pay an annual rental of $12,000 to the Water Department.

When Oil Barrels Become Silos

(Continued from page 413)

tainers were opened on November 20. With the exception of Russian thistle, contained in one of the principal silage mixtures, the stored product was in prime condition

When using motor-oil barrels as substitutes for regulation silos the investigators conducting the tests in South Dakota specify that utmost caution must be exercised in tamping the forage into the makeshift containers.

Alfalfa, sweet clover, sudan grass, corn sorghum, soy beans, Russian thistle, and wild sunflower were among the crops included in the major combinations already previously referred to in this article. The Russian weed alone evidenced a black and watery condition when taken from the containers, cattle refusing the uninviting product. Palatability experiments were conducted with the ensilage observations

The South Dakota experiments, both chemical and biological in their search, will continue this year on a more comprehensive plan. Already the conclusions are such as to warrant the official statement that compactness is the predominating word in preserving the freshness of ensilage, whether the container is a standard silo or a makeshift, inexpensive motor-oil barrel The continuous investigations, operating at a low figure, will be almost limitless in their scope of including plants whose identity as silage-substance has not heretofore been established.

The Electric Billy Goat and Its Work

(Continued from page 418)

butts the rear of the standard coal car. This action pushes the car up the long incline until it reaches the top over the hopper where it discharges its coal through gates on the bottom of the car. Tracks are on each side of the coaling house so that locomotives can get their coal from chutes which are on each side of the house. After the car is emptied, it is started down the incline and in this case pushes against the "billy goat." At the bottom of the run the "billy goat" is allowed to travel at full speed so that it can get away from the car which slows down when leaving the incline and going on the level track. The "billy goat" then goes out of sight between the rails and the car takes a flying switch on to a side track used only for empties.

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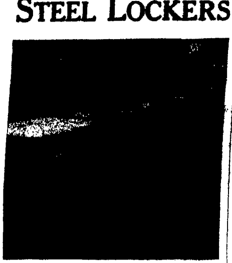

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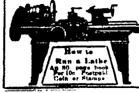

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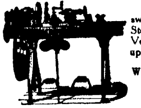

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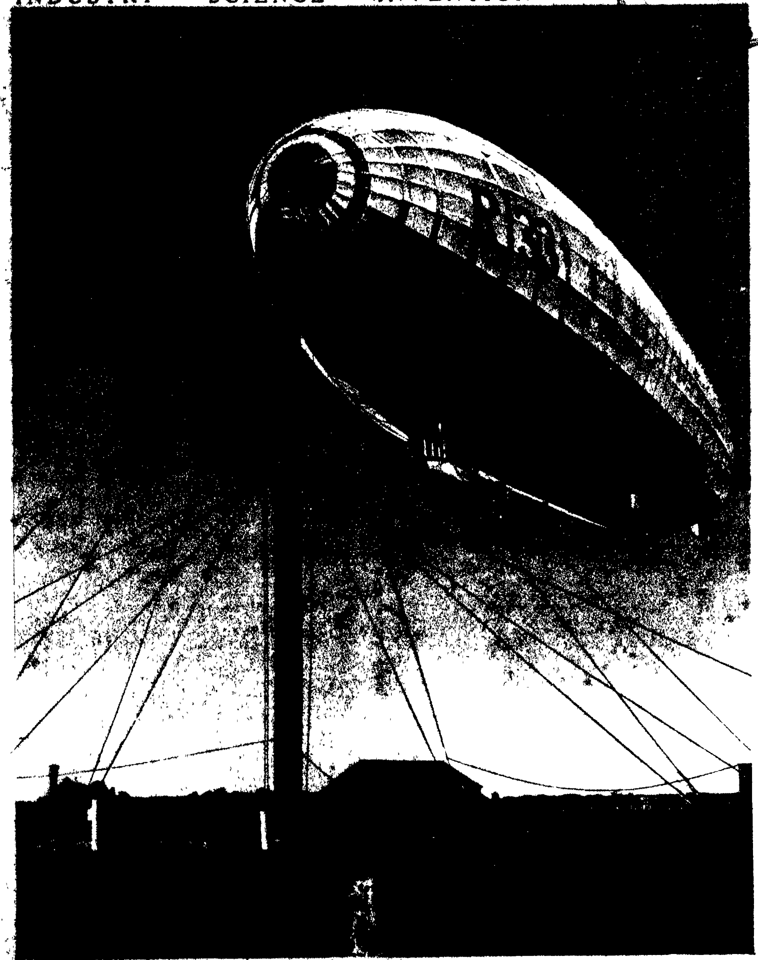

AN AERIAL GREYHOUND RIDING AT ANCHOR: HOW THE DIRIGIBLE MOORING MAST IS EMPLOYED

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May 28, 1921

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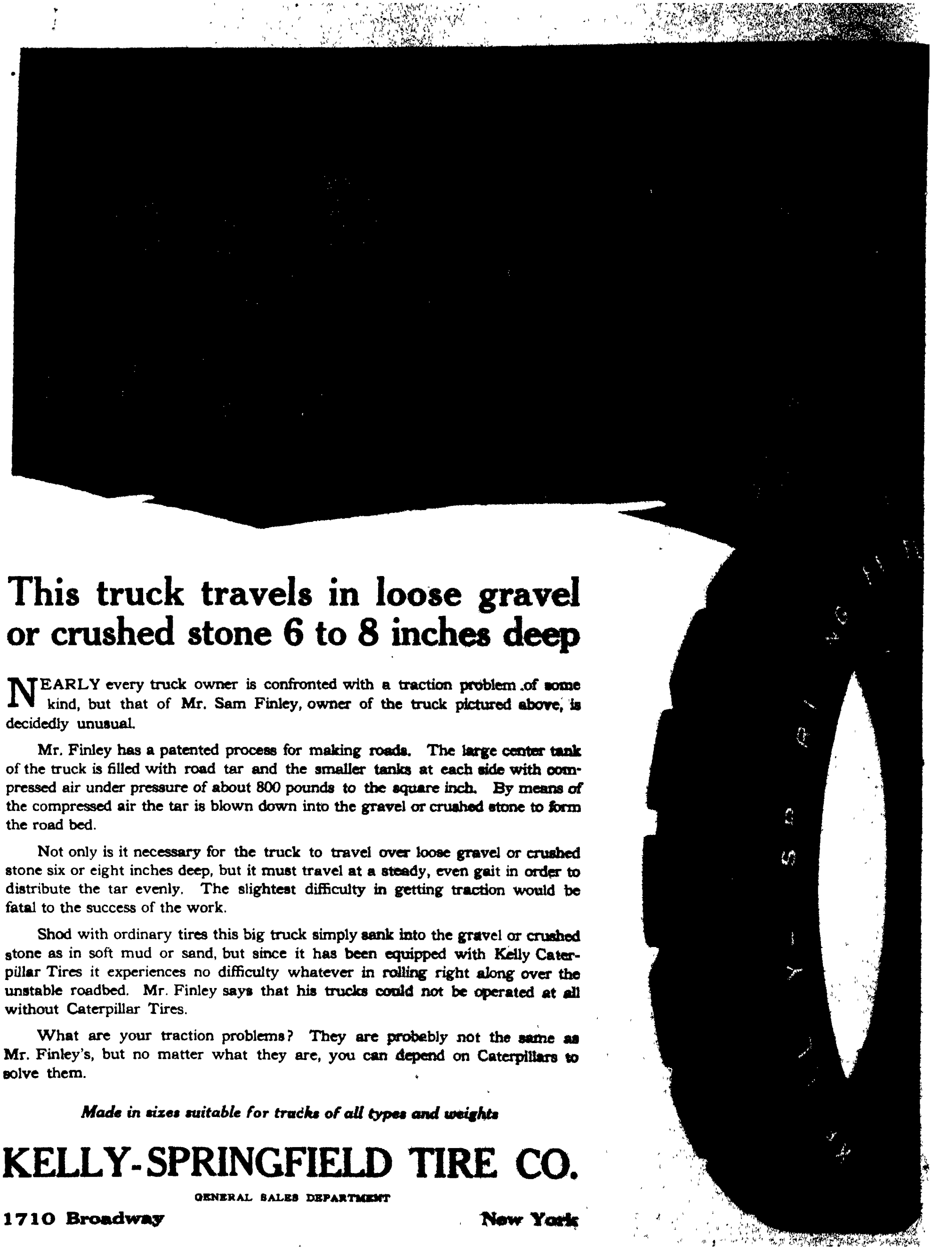

This truck travels in loose gravel or crushed stone 6 to 8 inches deep

NEARLY every truck owner is confronted with a traction problem of some kind, but that of Mr. Sam Finley, owner of the truck pictured above, is decidedly unusual.

Mr. Finley has a patented process for making roads. The large center tank of the truck is filled with road tar and the smaller tanks at each side with compressed air under pressure of about 800 pounds to the square inch. By means of the compressed air the tar is blown down into the gravel or crushed stone to form the road bed.

Not only is it necessary for the truck to travel over loose gravel or crushed stone six or eight inches deep, but it must travel at a steady, even gait in order to distribute the tar evenly. The slightest difficulty in getting traction would be fatal to the success of the work.

Shod with ordinary tires this big truck simply sank into the gravel or crushed stone as in soft mud or sand, but since it has been equipped with Kelly Caterpillar Tires it experiences no difficulty whatever in rolling right along over the unstable roadbed. Mr. Finley says that his trucks could not be operated at all without Caterpillar Tires.

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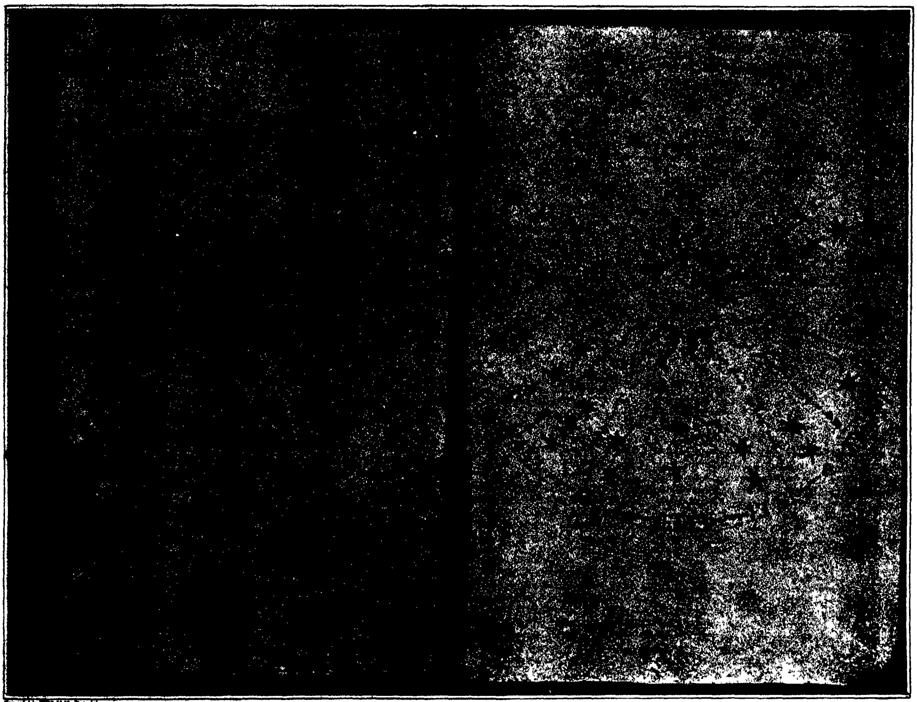

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Two representative pages from the Roger Bacon cipher manuscript recently put before the public—[See page 432]

THE page at the left is the one in which the translator finds reference to an annular eclipse on a date in the thirteenth century when such an eclipse is known to have occurred. The central picture, if this interpretation of the cipher be correct, represents the eclipse, the projecting corners being doubtless due to a combination of the artist's weakness in all matters of detail and his effort to represent the solar prominences as he saw them during the eclipse. The other drawings surrounding the central one are in several ways strongly suggestive of the presumably biological pictures in other parts of the book. Whether we are to infer that the scribe was trying to establish some connection between the eclipse and the subject which he was discussing with such drawings, or whether this juxtaposition is merely evidence that the cipher and the central drawing have been misinterpreted, must be left to the individual reader to decide for himself. The right-hand page is plainly on some astrological subject, but has not yet yielded to the translator's attack.—[See page 432]

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The Senate and the People

PRESUMABLY, in a democratic or popular form of government such as our own, it is the duty of the Senate to consult the wishes of the people of the United States and to govern themselves accordingly when they speak and vote upon the floor of the Senate No better illustration of the functioning of this relationship has occurred than was manifested during the late war Throughout that terrific crisis the Senate kept its hand upon the pulse of public opinion, with the result that there was a unity of thought and action which contributed immeasurably to the speedy and successful conclusion of the war

Today the Senate is out of touch with the people The harmony which prevailed during the war has been lost in these last few months of the peace, and today the thought and purpose of the Senate and of the people are flowing along two widely diverging channels This division is due to public recognition of the needless scale of naval expenditure The people who pay the taxes have learned to their amazement that last year out of every dollar of Government expenditure, 92 cents was spent in liquidating past wars and making ready for those of the future, and they have told the Senate in unmistakable fashion that Government expenditures must be reduced and that to their thinking the most effective and immediate way to set about this is to cut down the military budgets In spite of the fact that the Navy Bill, as passed by the House, called for $400,000,000, or two-and a-half times the peacetime expenditure before the war, the Senate wishes to add 100 million dollars to that huge sum , so that, today if you please, *after two-and a half* years of peace and with no possible enemy in sight the Senate is seeking to burden our already over burdened country by imposing upon it an expenditure for the Navy for one single year, of about half a billion dollars

The President has stated on various occasions that he is in favor of an international conference to secure a reduction of naval expenditures The people of the United States have noted with deep satisfaction that *the spokesmen for leading naval powers* have welcomed this suggestion of our President, and they are curious to know why in the world the invitation has not been sent out For answer they are told by various Senators that naval economy is an idle dream and that a conference *just now to promote* all around *retrenchment* would be ' premature —premature for some mysterious reason which the public is not allowed to know

The public, however, has a perfect right to make its own guess, and its guess is that the Senate is determined to jam through the construction of the whole of the 1916 program, conference or no conference To do that calls for the expenditure of about 250 million dollars for six super dreadnaughts which are not justified by the present international situation, as the following facts will show

Naval strength is relative We all want a strong navy, and we have got it Great Britain was formerly the strongest naval power She is no longer that, for we have taken or soon shall have taken, her place This rapid change in the situation is due to the fact that since the armistice while we have been building 17 super-dreadnaughts she has been building nothing and has scrapped 38 battleships and battlecruisers, to say nothing of 83 cruisers 300 destroyers and over 100 submarines—in other words while we have been building warships she has been destroying them

In view of the fact that Great Britain has already disarmed to the extent of scrapping a navy more powerful than the one we possessed in 1914, how in the world can Senator Penrose make the statement , "I look on disarmament as purely an idealistic and nebulous theory?" It looks as though this gentleman either had been living in a land of dreams or had been indulging in a Rip Van Winkle sleep But there is none of the soothing of sleep or the magic of dreams about an appropriation of 500 million dollars as an added burden upon the already burdened purse of the good citizens of the United States

Senator Borah has the people behind him in his plea for an immediate international conference The Senate should act accordingly

A New Dispensary of Popular Science

IN the absence of a benevolent despot to see that all moves as it should, any activity inevitably stands or falls, in the long run, on the basis of the degree *to which it enlists public support* On this ground as well as on the ground that the citizen ought to be in a position best to avail himself of what science teaches, and to estimate at its true value the work of the serious scientist as well as the claims of the faker, it is es*sential that the people at large* understand the aims, the spirit and the achievement of modern science, and possess in the bargain some grasp of its major details

Our common schools, beyond which a majority of us never go, are too busy laying the foundations for a *useful and an interesting life to attend to* anything else Our high schools, through which a considerable proportion of us pass in part at least, have turned their attention so strongly toward specific preparation for the serious business of earning a living that they, too, lack the *time for subjects* which they are inclined to regard as purely cultural and therefore incidental Our colleges turn out men and women supposedly grounded in science, but in small numbers And in any event, education in science is a process which may not be *suspended at the end of a stated period* , it must be carried on consciously throughout the span of life A mere examination of the dictionary will demonstrate that the man who ceased the acquisition of scientific information thirty years ago would be an intellectual cripple beside the *newsboy of today*, and would actually be unable to pursue the ordinary life of the present generation

This rapid advance spelling an increased complexity, is a tremendous discouragement to the man who tries to keep up with science *He finds a gap* between the place where his education stopped and the place where the current science starts—a gap which widens with each year and which he possesses no means to bridge for himself The efforts of the popular science magazines to bridge it for him are successful in individual cases, but a material part of the public never sees these periodicals Moreover, the editor himself finds it increasingly difficult to be sure that he has missed nothing of importance, and to pass an accurate judgment upon the things that he does not miss

Under the financial support of Mr E W Scripps, whose name is familiar to the readers of several hundred newspapers that avail themselves of his news service, a foundation has been laid in Washington which it is hoped will measure up to this situation The charter is a wide one, enabling Science Service, as it is to be called, to publish books and magazines, to conduct lectures and conferences and to produce motion pictures It will not at present publish any periodical of its own, believing that better results can be attained by coöperation with those already in the field, and especially by extending the willingness and the ability of the average newspaper to deal with scientific news

Science Service, in the words of Dr E E Slosson the editorial head, will aim to act as a sort of liaison officer between scientific circles and the outside world We may not all go as far as Tolstoy who held that you can explain Kant to a peasant if you understand Kant well enough But in its effort to get the best possible quality of popular science writing, and to get it before the largest possible number of readers, Science Service ought often to find it possible to function to better effect than the individual editor now is able to function It hopes in doing this to make both ends meet, and the fact that in many cases it can do, once for all, what numerous editors have been in the habit of doing for themselves, ought to help in this direction But if it cannot perform its mission and make both ends meet, it will perform its mission anyhow. We may all wish it success.

The Problem of a Canal at Nicaragua

A DISPATCH from Managua, Nicaragua, states that an American Government commission has begun the work of placing a valuation on the land which it would be necessary to purchase for the building of an interoceanic canal To many of us this brief communication, tucked away in a rather obscure corner of a daily paper, brought to mind the vigorous controversy which raged some twenty years ago around the question as to whether we should build an all-American canal at Nicaragua or purchase and complete the French canal at Panama. Fortunately, common sense prevailed in this discussion, and today the shorter canal is in daily operation.

Considering that the rival canal at Nicaragua would have been about 185 miles in length as against the 50 mile length of the Panama Canal, anyone unacquainted with the topography of the country would wonder why in the world the longer canal was ever seriously considered The answer is to be found in the existence of Lake Nicaragua, which provided a stretch of 50 miles of fresh water navigation, through a summit level lake, which provided an abundant water supply for lockages, a problem which the engineers of the Panama Canal were able to solve only by the construction of the artificial Gatun Lake The outflow of Lake Nicaragua is by way of the San Juan, a noble stream of great volume, with an average width of 1,500 feet, and a flood discharge which has been variously estimated at from 60,000 to as high as 150,000 cubic feet per second.

The proposal to build a canal along this route involves some novel and daring engineering work. The survey made some thirty years ago by the engineer of the Maritime Canal Company, Mr A G Menocal, called for the construction of a canal with a depth of 28 feet He proposed to extend the summit level of Lake Nicaragua, which stood at 110 feet, almost from the Pacific to the Atlantic, by the construction of two great dams, one on the Pacific slope of the western divide at a narrow gorge of the Rio Grande Valley, situated about four miles from the Pacific, and another dam at Ochoa, a point on the San Juan River, 64 miles to the east of the lake This dam was to be a huge rock fill 2,000 feet in length, and it would have flooded both the San Juan and tributary valleys, forming a chain of lakes

Between the Ochoa dam and the sea, the San Juan flows through low marshy land where canal construction would have been hazardous, and consequently the line of the canal was diverted from the river and located along the foothills of the valley until the Atlantic was reached at Greytown This involved the construction of huge retaining walls to enclose the canal prism on the valley side of the canal—a construction which was severely criticised by the engineers of that day

A comparison of the respective engineering features of the two canals shows why the choice of Panama was inevitable Thus, the summit level of a Nicaraguan canal would have been 20 feet higher than that at Panama The estimated total length of curvature in the Panama Canal was 22.85 miles, and the total number of degrees of curvature, 771 deg ; the Nicaragua survey called for about 50 miles of curvature, which was so sharp as to run up a total of 2,339 degrees. The estimated length at Panama was 49 miles only, against an estimated length of canal at Nicaragua of 186.53 miles , and, finally, of two 18-knot ships starting from the Atlantic for the Pacific, the one using the Panama Canal would be 378 knots out on the Pacific by the time a ship using the Nicaraguan route reached the same ocean

The estimated cost of completing the Panama Canal was about 145 million dollars, and the cost of the Nicaraguan project, 190 million dollars The Panama Canal was enlarged from a 28- to a 40-foot depth, and it cost nearly 400 million dollars. A Nicaraguan canal, built with the same depth and bottom and surface width throughout, we do not hesitate to say, would cost, in these days of high material and labor costs, fully 775 million dollars.

Electricity

Wireless Station at Tsingtau.—According to reports the wireless station now being erected by the Japanese in Tsingtau is expected to be in operation by August, 1921. The station will be used for commercial purposes and be open to all nationalities. The plant will have two towers, each 110 meters high.

A New Type of Neon Lamp, with a consumption of 5 watts, has been brought out for purposes where lamps are only required for indicating or signaling, and the smallest size of metal filament available for ordinary voltages has a greater consumption than is desirable. These lamps are stated to be very durable, and they give a reddish light; even smaller sizes are made suitable for illuminated signs, etc.

The Aurora and Communication.—The recent aurora which was so evident in the vicinity of New York City appears to have played havoc with telegraph, telephone and cable lines. The Western Union Telegraph Company reports that the magnetic disturbances accompanying the aurora on May 15th blew out fuses, injured electrical apparatus and did other things which had never been caused by any ground and ocean currents known in the past. It appears as though the company will probably have to send out ships to drag up the cables to repair the damage produced by straying currents.

A Fire Detector. — There has recently been introduced a compact fire detector which may be installed anywhere in conjunction with a simple electric bell and a few dry cells. The device is a highly sensitive automatic fire detector which quickly acts when the temperature rises above the ordinary It is adjustable, can be tested, is so simple that it cannot get out of order, and can be installed by anyone. The detector may be installed in the cellar of the private house, the attic, the kitchen and elsewhere, either in single or multiple arrangement, so as to give warning of fire at the moment such fire breaks out. Again, it may be installed in the office, shop, factory or store

Radiophone Music.—It appears very much as though we are on the verge of a new era in radio communication, namely, radiophone music for the home The idea, in brief, is to have radiophone stations at central points sending out concert music as well as speeches and lectures via radio, and compact and simple radio receiving sets in various homes, clubs and so on to intercept the waves. Already there are several radiophone stations in operation, and at least one wireless company has developed a receiving set made in the form of a cabinet phonograph, incorporating a concealed loud-speaking telephone unit, so that the music, speech, lecture or other radiophone transmission can be heard throughout a room. It is believed by radio men that leading manufacturers of radio equipment will see fit to maintain radiophone concert and lecture services for their patrons

Airplane as Cable Layer. — A six-mile stretch of land telegraph cables was laid and put into service in eight minutes by a plane that came from its station 40 miles away in Sweden recently. Of the eight minutes, six were spent in flight and the other two in making connections, according to *Electrical Review* Great possibilities, both military and commercial, are seen by air service officers in this new enterprise Equipment of planes for cable laying is simple and inexpensive. The cable is unreeled from the machine in flight with a flag marker at the end to guide signalmen on the ground to it When over the point at the other end of the stretch of ground to be covered the wire is cut from the reel and the free end weighted, marked and dropped The men below merely have to pick it up and connect it to begin talking with the forces at the other end.

Hot Water at the Faucet.—In the country, in the shop or factory and in other establishments where hot water is not always on tap, so to speak, the electric water heater fills what has hitherto been a serious void. There are two general classes of electric heaters, namely, the class that fits directly on the faucet, and the class that fits in the usual range boiler. The faucet type is convenient where small quantities of hot water are wanted instantaneously, without preparation of any kind. The device is connected directly with the plumbing system at the faucet, and two wires from the electric circuit serve to furnish the necessary current. The range boiler type is mounted inside the usual range boiler. The unit is always surrounded by the body of water being heated, and there is claimed to be no heat loss. The element in one of the types offered is enclosed in a seamless copper tube, eliminating corrosion for all time and affording 50 per cent quicker heat transmission, according to the manufacturer's claims.

Science

Burroughs Memorial. — The Burroughs Memorial Forest at Big Indian in the Catskill Mountains was dedicated May 6th with appropriate ceremonies. A tablet at the entrance to the forest was unveiled

Aluminum-Bearing Deposits in Hungary.—One of the largest aluminum bearing deposits in the world has been discovered near Tapolcza, Hungary It is believed to contain a possible deposit yielding 150,000,000 tons of aluminum

A Two-Billion-Fish Tragedy.—A sudden freeze on January 30th of this year cost the lives of 2,000,000,000 good sized herring at Klawack Bay, Prince of Wales Island, Alaska. The fish tried vainly to get out to sea, but without avail. Expert canners gave this number of fish lost as conservative

Fire Protection for the Holy Sepulchre.—Provision for the protection of the Holy Sepulchre against fire has been made by Sir Herbert Samuel, High Commissioner for Palestine. He recently visited this most notable shrine of Christendom and saw that no arrangements had been made to cope with fire He ordered three portable fire pumps to be sent from England, and has presented them as a personal gift to the Latin, Greek and Armenian representatives, which exercise control over the Holy Sepulchre.

Decay of Audubon's Home.—The house where John James Audubon made his home and where Professor Morse installed and tried out his first telegraph instrument is falling into decay. It is located at Riverside Drive and 156th Street This is a shrine at once for the naturalist, the artist and the inventor Apartment houses are crowding all around it, but it is built on a low level so that it is hoped that the real estate operator will be estopped for the time being as the site would call for an immense foundation for a large building In the village of Audubon in Pennsylvania all the Audubon landmarks have been carefully preserved

Recent Light on Stonehenge.—A few months ago we published an interesting article on Stonehenge The later developments are interesting The use of levers and inclined planes of earth gives no satisfactory explanation, as to the raising and lowering of the great stones and seems absolutely excluded on the evidence of one of the existing lintels This shows an enlargement of the mortises along the length of the under side of the stone, which can only be the correction of a miscalculation discovered when the lintel was being lowered on to the tenons To make the necessary alteration the lintel must have been removed, and this could scarcely have been effected without the use of some form of rope and a method of slinging, such as would not be at the command of a primitive and uncivilized community

Edward B. Rosa.—Everyone who has had dealings with the Bureau of Standards will recognize the name which appears in the announcement of May 17th that Dr Edward B Rosa, the Bureau's chief physicist, died suddenly at his desk on that day Born in Rogersville, N. Y, in 1861, and graduated from Wesleyan in 1886, he spent the rest of a busy life in the service of science After studying at Johns Hopkins, and instructing at Wesleyan and Wisconsin, he entered the Bureau of Standards in 1901 and has remained there ever since Among the work with which his name is associated are found the respiration calorimeter used in food-value investigations, the determination of the ampere, the computing of inductions, and the determination of the laws of electrolytic corrosion During the war he was one of the heavy contributors to the development of sound ranging, the geophone, aircraft radio apparatus and directional wireless.

Development of Palestine.—Rapid progress is being made in developing Palestine under British Government for the Holy Land is now governed under a mandate There are 600,000 inhabitants of whom only 100,000 are Jews. The Turks did everything possible during the war to ruin the country Palestine is a very small country, and an agricultural one resembling in topography Spain or Southern Italy There is much waste land which will be reclaimed by irrigation It is believed that a second California can be created Palestine now exports barley, oranges olives, olive oil and wines. There are two growing seasons in the year, and the soil when irrigated is most productive Near Jaffa there are 1,000 acres of vineyards Almonds are grown there and wonderful oranges and grapefruit The colonists are just beginning to develop the fruit growing possibilities but today throughout Palestine one can see the terraced hillsides that made the whole country a garden 2,000 years ago and it will not be difficult to make the country a garden again

Engineering

River Erosion and Bank Protection. — From the *Railway Age* we learn that the Natchez and Southern Railroad at Natchez, Miss, has tracks which are located for some miles along the bank of the Mississippi River, and considerable trouble has been caused by erosion. A novel method of protection has been adopted, this being the restoration of the toe of the bank by sedimentation, following the construction of a mud cell dyke, the whole being finally protected with concrete slabs.

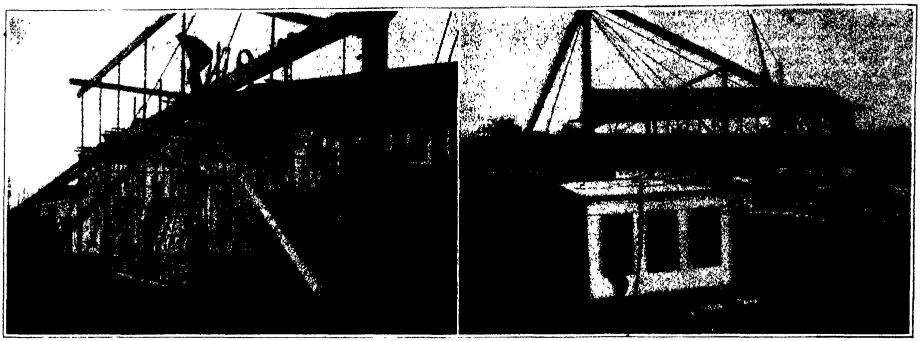
What Different Pavements Cost.—The costs of various kinds of surfacings on 3 41 miles of road forming part of a test road built in 1912-1913 by the Bureau of Highways, Philadelphia, are given in a recent issue of *Engineering News-Record* Twenty-six sections were laid, of which 6 were bituminous macadam mixed method, 8 bituminous penetration macadam, five of concrete base with a bituminous top, 7 vitrified brick Averaging the first cost, interest at 4 per cent for seven years, and the maintenance, the total cost on January 1, 1920, was $1 7738 per square yard for bituminous macadam penetration sections, as compared with $2 0776 for bituminous mixed method macadam, $3 0006 for concrete, and $3 5109 for brick.

Motor Snowplows in Norway. — The motor snowplow experiments have been successful to such an extent in northern Norway that it is expected that several municipalities will adopt this method next year As the roads are the only means of communication for most of the country, and as they are often too narrow for two sleighs to pass, it is necessary that they be kept open The first difficulty was to obtain powerful enough automobiles or tractors The ordinary truck and even agricultural tractor have not sufficient power to draw the plows when the snow is heavy, and it seems to be the opinion that a four-wheel drive is essential. Trucks would be preferred to tractors, if they could perform this work, because of their utility for other purposes

Hydroelectric Power Plant in Philippines. — What promises to be the most extensive private venture of the kind in the Philippines is now well under way in the form of a hydroelectric project designed to furnish lighting and electric power to the provinces of Bataan and Pampamga, comprising a population of approximately 48,000 The Abo Abo and Tiawir Rivers, believed to be able to yield a capacity of some 200 horsepower each, will be utilized for the project Field explorations of the district from which the company will develop electric power has revealed the existence of large deposits of magnetic iron ore The iron is known to stand a high degree of temperature and is very suitable for internal combustion engines Its electric treatment has proven quite successful and the company expects to be able to exploit it to a maximum degree

The Building Problem. — In Great Britain, France, Germany, Belgium and elsewhere, as well as in the United States, the question of the hour is housing. Many families seek to own their own home, yet with prohibitive rates for labor and materials, such hopes are soon dashed to pieces A quite natural reaction has been a veritable avalanche of new ideas in the way of materials equipment, and odd methods of construction which have been featured at the numerous housing expositions being held throughout the world New York recently held a housing exposition, which was attended by tens of thousands of New Yorkers anxiously seeking ways and means of building a small cottage on their limited means Chicago had a similar exposition, and reports come to us of expositions in London, Paris, Brussels and other European centers Never before was there a better opportunity for the man with the novel building idea

The Port of Paris.—A scheme for the creation of inland harbors, described by M Autrand, Prefect of the Seine, to the Improvements Committee of the Port of Paris, is of the first importance among the numerous proposals for the development of the city now being examined by municipal authorities, according to *The Times Trade Supplement* The Port of Paris will consist of three large inland harbors Gennevilliers north of Paris, which will be the real maritime port of the city, and will maintain direct traffic with the sea Bonneuil, on the Marne, which will control the upper Marne and the upper Seine; and Pontin, on the Ourcq Canal, which will be linked up directly with the Canal du Nord All three harbors will be connected by railways with the main systems Finally, the idea is entertained of constructing in the clayish soil around Le Gault large reservoirs which, while regularizing the flow of the Seine, will conserve considerable hydraulic power.



Two stages in the manufacture of the Lake concrete unit dwellings which are completed with plumbing, wiring and other accessories before shipment to the buyer

The One-Piece House

Simon Lake's Scheme for Producing Ready-to-Live-In Concrete Unit Dwellings and Transporting Them to the Site

By Harry A. Mount

> *THE housing shortage will be with us for several years to come, build as we may The plain truth is that we cannot hope to wipe out a building shortage that has taken six or seven years to attain its present magnitude, even by the most extraordinary efforts, except by building to our utmost capacity for many years to come. If anything, the hope of ameliorating the housing shortage rests rather in the introduction of new and revolutionizing designs and methods of construction, and to that end numerous inventors, engineers and architects have directed their recent efforts Dwellings must be simplified; materials other than wood must be employed; machinery and labor-saving equipment must be used to a greater degree, to the end that building costs may be appreciably reduced, finally bringing down the price of a modest dwelling to well within the means of the average American citizen Conspicuous among the numerous schemes proposed is that put forward by Simon Lake of torpedo-boat fame, in collaboration with Robert C. Lafferty, a New York architect The scheme is highly ingenious; it has been tried out with success; it is about to be put into production The Lake concrete unit dwelling is quite small, but sufficient by itself for the requirements of the small family. At any rate, we have asked Mr. Mount to tell us about Mr. Lake's housing scheme, which he has done in the accompanying article* —THE EDITOR.

WHEN one recalls the wide heraldry given a few years ago to the scheme of Thomas Edison for building monolithic cement houses from forms or molds that were to be used over and over again, one is warned to hold within bounds his enthusiasm over similar projects The Edison scheme was practical—is practical, in fact, and being used here and there on a small scale It has not been applied on a universal scale, as was so confidently expected Now comes Simon Lake of torpedo boat fame, who says he has found and removed the flaws in Edison's plan and is preparing to put his new scheme into effect on a nation-wide scale.

The most remarkable part of Mr Lake's scheme is that, instead of building the house on the lot, necessitating a vast amount of labor for putting up and tearing down expensive forms, he will build monolithic concrete units from standardized forms in well equipped factories, and deliver the finished house, ready for occupancy, to the lot!

At first thought there seems to be insurmountable difficulties to any such proposition How could a concrete house, no matter how small, be built light enough and at the same time strong enough for transportation? But supposing that were possible, where could we find a vehicle that would pick up and carry a house of any size a reasonable distance without prohibitive cost?

In finding an answer to these questions, Mr Lake and his collaborator in the enterprise Robert C Lafferty, a New York architect, have departed so far from standard practise that they have had to manufacture their own engineering data as they went, and some of their answers are nothing short of startling

For instance, the walls, floors and ceilings of the house are hollow, with only ⅜-inch thickness of cement on the inside and ⅝-inch on the outside And yet a house of this construction has stood tests more severe than if it had passed through a half dozen San Francisco earthquakes without a crack or a sign of structural weakness

These tests included transportation by motor truck five miles at speeds up to 15 miles an hour And such a motor truck! It is a specially designed ten-wheel affair, which carries the house swung low on a structural steel cradle It is equipped with hoists, and other machinery for handling the house in putting it on and taking it off the truck It is believed that two men can load, deliver and set up a house complete within a radius of fifty miles of the factory in one day.

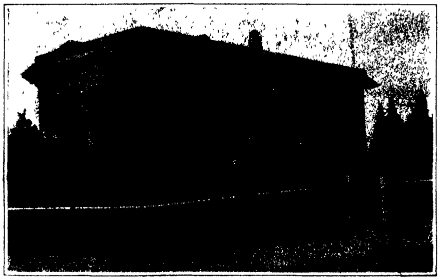
As startling as are the engineering features of the house, they are hardly less so than the architectural features, the work of Mr. Lafferty. By the application of a number of ingenious devices one unit of this construction, measuring 12½ by 28½ feet, is made to serve all the practical purposes of a five-room house

In a house built of more than one unit, the feature which first recommends itself is the infinite variety of combinations and finishes possible in treating both the interior and exterior Doors, windows, walls, etc, are not arbitrarily fixed, and the effects may be varied to suit individual taste In fact, the only limiting factor in design is the size of the units, although two of them may be combined to form a single large room Thus it is possible to produce from these units a tiny dwelling, a mansion, or a five- or six-family apartment house.

In this connection the one unit house is of particular interest, for it represents housing reduced to its lowest terms These units will sell, complete and delivered on to the foundation, for as little as $1,500

The front door opens into a little vestibule, with a coat closet The center of the house is occupied by a combined dining and living room, although ordinarily there is no hint that it is used for meals A large mirror on one wall, when swung down and rested on two folding legs, becomes the dining room table This discloses, behind the mirror, a revolving server which communicates with the kitchen When the meal is finished the dishes are piled on the server and when this is revolved they are transferred to the kitchen at the sink. The kitchen contains besides the sink a four-burner gas stove and oven, refrigerator and an electric washer Opposite the kitchen door is the bath, fully equipped At one end of the house, off the living room, is a small sun room with a built-in window seat. Communicating with this is a small dressing room. At the other end of the house is a den, with identical arrangement. In each of these two rooms full-sized beds disappear into the ceiling, the bottom of the bed serving as a large section of the ceiling These beds are lowered by means of a crank in the dressing room, and at night one end rests on the window seat and the other on two folding legs.

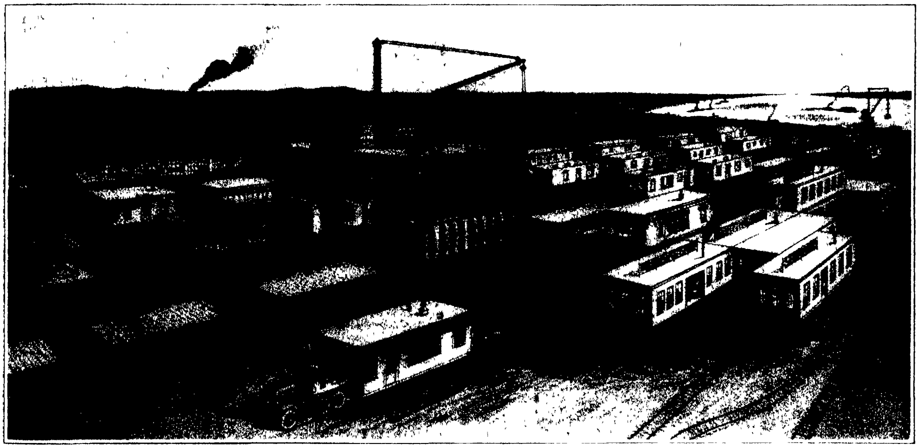
Glass doors which may be used to shut off the sun room at night, slide back and



A single unit dwelling built by the Lake method and subjected to numerous tests with marked success form doors for book cases on either side of the doorway in the daytime. The heating plant is a small stove in a fireproof alcove off the hallway, and this has been found sufficient to heat the house in the coldest weather Further plans include a coal bin on the roof, holding two tons, arranged so that by pulling a lever the fuel drops directly into the stove

The success of the scheme depends largely upon a unique method of construction, upon which Mr Lake has been allowed broad basic patents The central piece of apparatus of his unit dwelling is a huge traveling-factory, crane-like affair, on which are mounted two cement mixtures with loading hopper bins placed over them. The sand and cement are lifted to these hoppers from railroad cars, which run beneath the apparatus, by means of a grab bucket

The cement, after mixing, flows by gravity into the forms. The frame of the house is first constructed of creosoted wood, on both sides of which is fastened heavy reinforcing netting. The window and door frames are then placed in position and the travelling plant moves to this position There are two heavy wood forms for both inside and outside walls, one on each side of the apparatus, so arranged as to counterbalance each other, so that when one is lowered the other is raised One of these forms is dropped over the prepared reinforcing. As door and window frames run through the walls, the frames seal these openings against cement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Bird's-eye view of a typical plant for producing the Lake concrete unit dwellings In the center foreground appears one of the special trucks for transporting the unit dwellings in one piece

The crucial part of the operation then begins The walls are made hollow by placing in the forms the "cores" of heavy sheet iron, properly reinforced to prevent collapsing Before placing these cores in position, they are dipped in a bath of asphalt until a coating nearly an eighth of an inch thick is deposited on them The cores are then placed in position and the cement is poured

Ordinarily it would be several days before the forms could be removed, and the cores would then be so tightly imbedded in the cement that they could not be removed. But warm air, held at a temperature of 180 degrees, is at once circulated through the hollow cores and a threefold result is achieved First the cement is dehydrated and dried within two and a half hours, secondly, the asphalt coating is melted so that the cores can be easily withdrawn, and thirdly, a heavy coating of asphalt is deposited on the inner lining of the walls, making them entirely water tight While the cement is still warm and the pores are open so that it readily absorbs liquids, a waterproof filler, tinted in some desirable shade, is sprayed on the outside walls. The house is then picked up by the traveling machine and deposited further down the yard where it is allowed to stand two weeks to allow the cement thoroughly to harden or season in order that the house may stand the handling necessary in transporting it to its final location Meanwhile the roof slab is placed on the four walls, the plumbing and electric wiring are completed, and the house finally finished for occupancy Even the electric light fixtures are hung and window shades are in place when the house is finally loaded on to the big truck and trundled off'

The finished unit weighs about fifteen tons, but by means of the special truck it is readily handled by two men. If the house is to rest on piers, these are first placed and the truck then drives between them, elevates the house to the proper height and sets it down The truck is then taken apart beneath the house and is withdrawn in two sections These sections are subsequently reunited and the truck is ready for another trip

The special motor truck carrier practically divides the load on two trucks comprising four forty-inch wheels each The solid rubber tires are each fourteen inches wide, so that the hard road contact is about 350 pounds per inch Where delivery is to be made over meadows or soft ground, a caterpillar belt will connect each adjoining pair of wheels, thus reducing the ground bearing to about 22 pounds to the square inch The truck, it is claimed, will attain a speed of 14 miles an hour and, when fully underslung, will carry the units under an eleven foot viaduct The truck's elevating apparatus allows the delivery of the second story of a two-story house first It is elevated to the proper height and propped in position The truck is withdrawn and returns with the first story unit, depositing it beneath The second story is then lowered in place, on top of the first story

The smallest economical plant will consist of one traveling cement machine, woodworking, plumbing and paint shops, and four delivery trucks The plant will complete the units at the rate of four a day For the first plant unit of this size an abandoned shipyard has been purchased at Bridgeport, Conn, and the plant is ready to begin production It is planned to deliver within a radius of fifty miles of this factory without extra charge, and gradually to establish branch factories in other centers of population

"Of course," said Mr. Lafferty, in discussing the new type of construction, "no single invention or method will solve the housing problem It is too big for that We cannot hope to build more than a small percentage of all the houses that are immediately needed

"Our chief aim has been to produce a home that anyone could afford to own I think a good remedy for the present discontent is to encourage the 60 per cent of our citizens who now live in rented homes to own, their own dwellings But even the most modest home should meet certain elementary requirements

"First of all, the construction must be economical, no matter what it is That excludes wood for we are using wood four times faster than we are producing it and it is certainly no longer an economical material

"For many years cement has been recognized as an ideal building material if it can be thoroughly damp proofed, if there is some means to dispense with the cost and waste of forms, and if, also, the requisite economy can be obtained while producing homes in an infinite variety of architectural designs

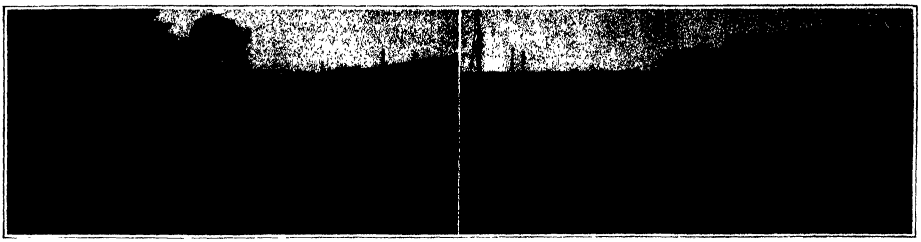
"We think our construction meets these requirements and others The house, by our process, is thoroughly damp-proofed It is also heat- and cold-proof, for the hollow walls are good insulators The house is as nearly fireproof as it can be made; the upkeep expense is minimized for no painting nor roofing is ever required The life of the building is several times that of a frame house We use an abundant raw material and employ the most economical production methods We use more unskilled labor than is the customary practice We have in our smaller units, recognized and solved the servant problem Other units can be added as desired In the one-unit house seventy five per cent of the furniture is built in, eliminating extravagant furnishings

One-Way British Motor Plows

AMONG the most interesting of recent developments in British agricultural engineering is the one-way motor plow, which has appeared upon the British market in the form—judging from field experiments—of a successful model Upon a commercial basis, this and other one-way plows will soon make their appearance

The one-way motor plow has features which recommend it to all farmers whose arable land is divided into comparatively small areas, as in this country, and also to those agriculturists abroad who require to economize the space left at the headlands One-way plowing, moreover, is a simple procedure which native labor can follow with little preliminary guidance for there is no demand upon the operator to exhibit skill in turning in a circumscribed area at the end of the furrow and simultaneously to lift the plow out of work The reasons for the popularity of the one-way system, therefore, are obvious

The one-way motor plow in the present case consists of six plow breasts, three being suspended from each end of the main carriage which is modeled on the lines of a tractor body and is driven by an engine sufficiently powerful to haul three furrows in the heaviest clay land The forward shares are held out of work as the motor plow proceeds across the field and automatically drop into work when the machine begins its return journey Plowing therefore becomes a succession of forward and return movements One type of one-way plow has the advantage that it can be used as a tractor to haul another implement or a laden wagon, for the plows can be removed



Left Crewless electric train rounding a curve having a radius of sixty-eight feet and a super-elevation of twenty degrees, at a speed of twenty miles an hour. *Right:* A non-stop crewless train passing the station

Electric Trains without Crews

An English Automatic Railway, Tested Before the War, Which Is Being Installed by the London Post Office

By Kenneth E. Stuart, A.S.M.E.

The selective mechanism installed on the truck of the crewless car for determining the stopping of the car at the right station

THE report of the New York, New Jersey Port and Harbor Development Commission, recently made public, presents a very comprehensive plan for the improvement of freight distribution in and about the port of New York Among the provisions of this scheme is one that may occasion some surprise among readers of the SCIENTIFIC AMERICAN on account of its novelty, namely, the recommendation for the construction of several miles of underground railway to be operated electrically under automatic control *i e*, without motormen on the trains Yet this is not an untried idea, an experimental railway constructed from the writer's designs having been operated in England for over three years, with very satisfactory results

The experimental railway referred to was constructed at Chelmsford, Essex (near London), and completed in 1912 It was half a mile in length and laid mostly upon the surface of the ground, although a portion of the line passed through a concrete lined tunnel The speed of the trains was thirty miles an hour.

Although it was realized that a practical solution of the problem of automatic control for electric trains would have many applications as, for instance, for urban freight, parcel and produce distribution, haulage of coal and ores over rough mining country, etc , the Chelmsford system was designed primarily with a view to solving the problem of dispatch of the mails through the phenomenally congested centers of London As long ago as 1912, over certain routes in London, the ordinary mail traffic during the busiest part of the day amounted to as much as twenty tons of mail per hour in each direction through street congestion fully equal to that of the most congested parts of New York at the present time The steamship mails passing through London en route for points upon the Continent were very much heavier still. It was stated in an official blue book issued about this time that the average speed of the motor mail vans in London had fallen to six miles per hour due to traffic difficulties This was the situation that led the British Postal Authorities to intimate that they would be interested in proposals for dealing with the mails by means of an underground electric railway.

The writer felt that no form of friction brake would be suitable for driverless trains, for the reason that, with friction brakes, braking distance is uncertain, and especially so with varying loads The writer therefore determined to use direct current propulsion, by means of shunt-wound motors, which would make it possible to employ motor braking of a very positive character, without the complication of any mechanical braking devices upon the cars Such a system would be regenerative not only in braking, but on descending gradients, thus saving the energy usually wasted by the brakes

The Chelmsford line was laid out in such a way as to embody all essential features of a working installation and encounter every difficulty likely to be met with in construction. The gradients ranged from level track to five per cent, both upward and downward, and in the middle of the line was a section of curve having a radius of only sixty-eight feet upon which the trains could not possibly have traveled at full speed without derailment, notwithstanding the fact that the outer rail was super-elevated twenty degrees above the inner. Although only one station was provided, it was arranged to typify either a terminal or an intermediate station with through tracks for non-stopping trains There was also a siding in the station, a loading platform and an unloading platform, with a control table located so as to command a view of the entire station From this table the cars could be backed off the siding, brought together for coupling into trains, moved on to the loading and unloading sections and dispatched.

As underground construction is expensive, even in London where the conditions are ideal for tunneling, the car unit was made as small as practical considerations would permit—that is to say, the cars were made just large enough to hold a mail bag of the largest size, or a flat parcel two feet square, the combined length and girth of which would be six feet, which is the limit set by the British Parcel Post regulations This resulted in a car two feet wide, two feet high and six feet long, inside measurements, with a track gage of sixteen inches The cars were of the four-wheeled type with a motor mounted over one axle and a compartment over the other which was available for par

(*Continued on page 435*)

Left: A station siding, showing the intricacies of a switch on this novel railway. *Right:* The control table for maneuvering the cars while in the station. In front of the operator is a diagram of the line upon which the movement of trains in transit is automatically indicated

Molasses for Fuel*

By S. R. Winters

THE United States may not duplicate the embarrassing procedure of Cuba—whereby sugar-manufacturing establishments through the force of economic necessity dump molasses into ditches and subsequently pay a penalty to the government for destroying property; but the urgency of the fuel problem lends emphasis to a new chemical and mechanical process for converting blackstrap molasses into a liquid fuel, with the residuum resolving itself into potash. Credit for the perfection of the formula, details of which are being withheld from the public, belongs to Dr. Paul G. Hildebrandt, formerly of Havana, Cuba, whose experiments were conducted in collaboration with Swarthmore College of Pennsylvania The inventor has sold his rights to United States basic patents to a group of Philadelphia individuals for $1,550,000, resulting in the formation of a corporation for the manufacture of blackstrap fuel and potash products

American magnesite quarries laid out on mountain side, surrounded by primeval forest and mountain lakes

Attempts to utilize low grade molasses as a fuel for half a century have proven unsuccessful; the tardy fruition of such efforts being realized in the newly-discovered chemical and mechanical process, according to claims. The molasses yields in British thermal units a fuel equal to that of coal, and after extracting the heating value from a ton of molasses there is a residuum of from 135 to 150 pounds of commercial potash. Laboratory experiments in Swarthmore College showed a production of 18,000 units of heat from a pound of blackstrap molasses, whereas the choicest pound of bituminous coal in the State of Pennsylvania is said to yield only 13,500 British thermal units. The waste product, after extracting the fuel from the molasses, resolved itself into potash usable as commercial fertilizer by the farmer or for industrial purposes

Cuba, as the truthfully described sugar bowl of the world, is to share the benefits of the machinery equipped and installed as models in the laboratories of Swarthmore College. The cost of labor and of fuel insures against the economical operation of sugar-manufacturing plants in Cuba The latter, as well as other sugar-producing countries, are not so fortunate as to have coal mines and oil wells Formerly, when sugar exportation was comparatively small, Cuba utilized the fiber from sugar cane and such wood as was available for fuel in the operation of sugar refineries. Today, with the increasing demands of a sweet tooth at home and abroad, Cuba has to look elsewhere for its fuel supply With coal $13 and even as high as $15 in this country, its exportation to the plantation jungles of interior Cuba naturally exacts a heavy transportation toll

Molasses-burning apparatus in operation at Swarthmore College, which is to serve as a model for the equipment to be installed in Cuba

Blackstrap molasses is a by-product as a resultant of extracting all the sugar from the juices of the cane. Obviously, then, the discovery of a chemical and mechanical process of converting low grade molasses into a liquid fuel at the sugar houses in Cuba facilitates the production of sugar by giving a cheap fuel, available at the mills. At present, the Cuban refineries discard the molasses as waste, pouring it into ditches, and pay a fine to the government as required when fish or other resources are destroyed. The costly operation of sugar-manufacturing establishments in Cuba, due to expensiveness of labor and fuel, has been responsible for a centralization of the business, to wit: with a 24,000 ton production of sugar in 1800 there were 870 factories, while in 1911, with nearly a 2,000,000-ton yield, there were only 168 manufacturing establishments

Molasses, previous to the enactment of national prohibition, was profitably employed in making liquors The revenue derived therefrom was diverted into channels for increasing the income of the sugar cane planter Since the enforcement of the prohibition law the value of low grade molasses has been reduced to utter worthliness Formerly it was exported at prices ranging from two to four cents a gallon, f o b Cuba Laborers in Cuban sugar houses have been demanding wages ranging from $8 to $12 a day The process of extracting sugar from cane as now practiced involves the

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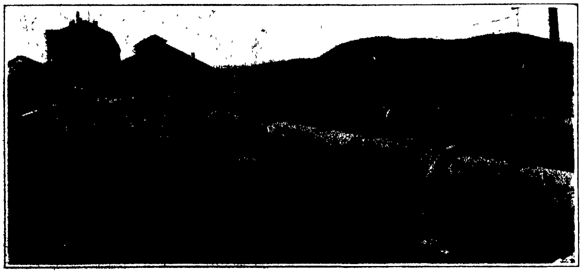


Revolving tubes in which magnesite is treated in converting it into the numerous commercial forms

American Magnesite

By A. R. Surface

THE extent to which the magnesite industry of the United States has expanded as a result of the war is little appreciated by the average citizen Before the war this mineral, used so extensively in the steel industry, was imported largely from Austria To-day most of it comes from the Pacific coast and particularly from the State of Washington, in Stevens County

The Stevens County magnesite quarries are laid out on mountain sides, as shown in accompanying view, surrounded by primeval forest and mountain lakes, they are particularly beautiful and spectacular At night, because of the huge furnaces and brilliantly lighted grounds, the works can be seen for miles Day and night shifts are run, the quarries being lighted

A conservative estimate of the already developed Stevens County deposits puts them at 50,000,000 tons, but much larger deposits are known to exist In color the magnesite presents many shades, red, pink, gray and white It is all crystalline, with bright, shiny cleavage faces, varying from the texture of granulated sugar to very coarse crystals In burning it does not crumble to powder, but dead-burns easily in lumps a foot through, in an ordinary lime kiln It is quarried in open cuts and is mined at low cost owing to its occurrence in immense beds There is also little waste in handling and sorting.

That magnesite will soon take its place as an important factor in building conditions in the form of plastic magnesite seems assured Foreign magnesite would be unable to compete with this new market, even if the tariff did not pass Congress As a first step to the manufacturing of plastic magnesite which will be used for the manufacturing of flooring and stucco work in building operations, the new kilns will be used Investigations show that there is now a normal consumption of 100 tons a day of plastic magnesite in the United States, while the demand is growing rapidly Within a year experts look for the demand to be 200 tons a day with a steady increase

Plastic magnesite is prepared by a process somewhat similar to the refractory magnesite except that in the furnaces or kilns it is not brought to the same high degree of heat as the refractory rock, the burning being done with very closely controlled temperatures After the lumps come out of the kiln they are ground to a powder of 200 mesh, which is of the same fineness as cement The powdered product will be placed in barrels or boxes and shipped out in carload lots to wholesalers Plastic magnesite has passed the test period in structural work and for some time has been used in fireproof buildings. Magnesite coating offers extreme resistance to cracking, is immune to water or heat and will not contract or expand under any climatic conditions

Army vs. Navy Ration

ARE sailors larger eaters than soldiers? This is answered in part by the appropriations for subsistence The army ration cost only 43 cents a day per man, the navy wanted 68 but accepted 60 cents per man. Naval experts urged the higher rate on the ground that better and more varied food was required for sea life than on land The necessary irregularity in the work day of the sailors has also something to do with their apparent voracious appetites

Reorganizing Our Government Machinery—I

How Thought and Care May Be Applied In Order to Eliminate Wasted Motion and Duplicated Effort

By C. H. Claudy

NOTHING can be successfully accomplished without a preconceived plan; whether one build a tool shed or a Woolworth Building, a scow or a battleship, draw a diagram or paint a masterpiece, a plan must be the foundation

But *any* plan will not do, and the plan must be such that when the structure or ship is built, the diagram drawn or the masterpiece painted, it will perform the *function for which it was created* In other words, the plan must be logical and properly conceived as well as properly executed

The plan of reorganization of the United States Government which is usually thought of, and which, because of its constant recurrence in people's minds, has come to be accepted as logical, is the grouping of "similar activities" so that the *manufacture* of the product will be most economically and efficiently accomplished

The idea is of constant recurrence because it is the business idea, the idea of the world of commerce, the accepted basis of almost all activity It is the best idea for commerce, business, and civilian activity, because manufacture and use are here things apart The maker of an automobile, or a typewriter, or a book, or a bale of hay, considers economy of production and lets the buyer worry about economy of use True, he desires that the user find the product *economical*, because the manufacturer desires the one-time purchaser to be a second time purchaser, the theory of profit and loss, of business and commerce enters into his manufacturing ideas, since he must please his customers or lose them But his fundamental principle is economy of production, that his sale price may be low, that he may sell much, and so make a profit

The Government is not concerned in profit and loss in the making of anything it uses It does not carry the mail to make a profit but to promote public welfare It does not operate a life-saving service for gain, but to protect lives and save property for its citizens It does not coin money to make a profit, but to serve the business interests of us all It does not make maps, or provide them, or work out agricultural problems, to make a money profit for the government machine but to make the lives of us all easier happier, better

Therefore, to reorganize the disorganized machine as if it were a sick manufacturing business, to consider reorganization merely on a basis of economy of *production*, is fundamentally wrong The important job before the Congress is not primarily to cut down costs but to promote efficiency Increased efficiency will cut down costs, first costs cut down with a legislative axe will so decrease efficiency that ultimate costs will rise

The principle on which the Government in general must be rebuilt, and particularly the principle upon which the scientific activities of the Government must be treated, if chaos is not to result is this The important end to be gained is the maximum and most efficient *use* of any product of any Government machine The product may be material aircraft, ships, guns greenback or powder or intangible time, information, theory, weather prediction, surveying or light and sound and signals *for mariners* In either *case* the principle is the same—economy and efficiency of *use* is to us who pay the bills the important thing If use can be served while economy of manufacture is also served, well and good If most efficient use demands a larger manufacturing cost than efficient use with a less cost, then the larger cost is the most economical This may be plainer with a concrete example

Much discussion has recently taken place regarding the advisability of the establishment of a Department of Aviation, in which all the Government's aerial activities could be centered Such a Department would provide planes and aviators for such diverse activities as mapping, exploration, mail-service, army, navy, surveys, life-saving service and transport It would have jurisdiction over air laws, regulations, landing fields, civilian and amateur flying and manufacture It would encourage, promote and assist in the development of new ideas—would, *in fact, be to aviation* what the Department of Agriculture is to the tilling of the soil and the *raising of stock*

There is small question but that such a Bureau, if not a Department, will eventually be created, although it may be but a part of a larger Bureau or Department of Transportation But to take from the Army and the Navy their planes, their aviators, their fields and hangars, would not promote efficiency of use of planes in war It *would* save money So would it save money to put all battleships out of commission until a war came along So would it save money never to hold target practice with fourteen inch guns So would it save money to maintain no military establishment in fact, but to have it entirely on paper

But the ends we wish to serve with our Army and Navy are those of defense, of preparedness for eventualities, of the possession of an expandable and efficient weapon which we pray we may never have to use, but which we want effective if we do have to use it Unless the profession of arms is allowed to do its own experimenting, develop its own weapons and practice its own men in their operation, it can never rise to the peak of efficiency

Here is the principle illustrated The essential thing in reorganization should be the *use*, not the *making*, of the product Granted that one central factory could make airplanes cheaper than two Granted that a civilian manufacturer could produce planes quicker and cheaper than either Army or Navy But can any but Army and Navy produce Army and Navy planes which will be as useful to Army and Navy as those produced in their own shops by Army and Navy?

There are many cases of duplication of effort and facility in the Government machine which can be, and should be, eliminated, which when eliminated by combination, will make for a greater efficiency of use as well as of manufacture There are, in the Government, nineteen agencies doing hydraulic construction, fifteen concerned with rivers and harbors, twenty-five working over buildings and grounds, construction and supervision, sixteen doing road construction, twenty-four doing mapping and chart work; fourteen concerned with public lands, sixteen agencies for chemical research, ten offices working with public health, fifteen with education; eleven dealing with foreign commerce, and so on. Doubtless many of these could be, should be, coalesced.

But they should not be combined merely because it *appears* as if they should or because economy of operation *alone* will result

Congress has created a Joint Commission to study Government reorganization. It will require at least a year and perhaps more, for this Joint Commission to make an exhaustive investigation and a report. In the meantime, well intentioned legislators are doing, or trying to do, curious things with the Government With the greatest possible respect for all legislators who introduce bills looking to changes in the Government machinery, it must nevertheless be chronicled that if a Joint Commission will require a year or years to find out what should be done, no one Senator or Representative is *competent to decide off-hand* and in advance that certain changes should be made There *is before the Senate a bill abolishing one and creating* two new departments and moving around, like chessmen on a board, a large number of Government bureaus. How the learned Senator who introduced this bill knows what he is doing or why, the present writer will not venture to say, he does say, and with emphasis that in haste lies danger, that it is far, far easier further to disrupt the already worn-out Government machinery than it is to rebuild it, and that one of the great causes of present Governmental inefficiency is hasty and ill-advised legislation

Another great cause of our Governmental machinery troubles is bureaucracy, politics and personal ambition To fill a need a certain Bureau is created, with a Chief and a Secretary The Chief does a good job, the Bureau grows, the Congress authorizes a larger number of clerks, the administration changes, the Chief dies, some one gets John Smith appointed as Chief The Bureau *ceases to be necessary or becomes so* nearly allied to another Bureau that it is a practical duplication Some one suggests its abolishment, or its merging with the other bureau John Smith, with pride in his job and a desire for his salary "lines up" as many legislators as he can, telling them *his* side of the story, and making them believe in the absolute necessity of the retention of *his* Bureau The Bureau stays Inefficiency triumphs Bureaucracy has its way.

No one in Washington wants to give up his job or his title The dog wants to swallow the tail and the tail desires to engulf the dog The greater is always trying to swallow the less; the less is forever trying to become the greater. When some legislator attempts to rearrange Bureaus A and B and C by taking them from their Departments and putting them under a newly created Department, he probably consults none of them, but as soon as they get wind of the change they are all upon his trail to convince him that A and B and C should be left alone or given the right to absorb the others

It is submitted that this Government machine of ours is far too important to all of us to be made the *sport of bureaucrats* or the nail on which legislators, well intentioned but ignorant, hang their publicity-hunting bills After all, this is *our* Government. *We* pay for it *We* support it. It is here to serve us *all* The thing we demand from it is service, first Give us *economy of operation if you can*, is our message to Uncle Sam, but give us service Let us be well governed What the Government makes, let it be well made, made so that it can be efficiently used

THE SCIENTIFIC AMERICAN *is in thorough agreement with Mr. Claudy as to the need of reorganization of the Government machinery We believe in the essential soundness of the idea of a Joint Commission of the Congress, which will painstakingly, deliberately and thoroughly investigate the present condition of this machinery, and as soberly and carefully advise as to changes. We believe that no change should be made without a hearing being given to all those who know anything of the bureau or office which is to be changed, of the bureau or office which will absorb the one to be eliminated, and of that portion of the public which is interested in the work of the bureau or office to be changed We believe that no vitally important piece of engineering can ever be successfully carried out without careful preliminary surveys and far-sighted planning, and so we venture a word of caution We believe this Government machine of ours far too important, inefficient though it undoubtedly is, to be changed at haphazard, altered without investigation, or rebuilt without careful and deliberate forethought.*—THE EDITOR.

Carburetor Economy

THAT of every gallon of gasoline used in a motor car nearly 30 per cent is wasted through faulty carburetor adjustment resulting in imperfect combustion, is one of the startling conclusions derived from exhaustive tests of the composition of automobile exhaust gases by three of the prominent chemists of the U S Bureau of Mines, working in coöperation with the New York and New Jersey State Bridge and Tunnel Commissions for the purpose of determining engineering facts in connection with the ventilation of vehicular tunnels. The experts who conducted these experiments state that careful carburetor adjustments should result in saving half this amount. They asserted that the great majority of motor cars and trucks are operated on rich mixtures suitable for maximum power but very wasteful from the standpoint of gasoline economy. They said that the average motor car carburetor is set for winter operation and is not changed in summer

They urged that the public should be impressed with the saving in gasoline resulting from the use of lean mixtures, and suggested the general installation of a small gas sampling tube in the exhaust pipe of motors, especially trucks and vehicles used by taxicab and trucking companies, for the purpose of securing carbon-dioxide determinations, thereby making proper carburetor adjustment possible. They pointed out that such companies could well afford to employ a chemist to make regular control tests, and that the results of such a practice would be great economy in operation.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

The Edison Questionnaire

To the Editor of the Scientific American:

I have been greatly diverted by the newspaper controversy over the test questions that Mr Edison has submitted to young college graduates, candidates for employment with his company

It seems to me that the criticisms on both sides have been unfair. In the first place, it is certainly Mr Edison's own business to adopt whatsoever measure he chooses for the qualifications of his employees, so that I think all criticism of the examinations on the ground of their unreasonableness and unfairness, is quite unjustified. On the other hand, it seems to me that Mr Edison jumped to a rash conclusion when he stated, if indeed he did so state, that higher education in the United States is a complete failure because most of the candidates failed to answer correctly most of his questions

The salient characteristic of Mr Edison's questions is that none of them investigates the candidates' powers of understanding I say none of them—I have seen two lists of 70-odd questions each, of which the foregoing statement is literally true, and then I have seen some isolated questions having to do with mechanics, of which the same criticism is more or less true because the questions stated contained insufficient data for a solution One such question is

A cannon ball weighing 100 pounds is let fall on an anvil two feet below it What is the force (maximum) of compression in pounds? To have its proper setting, this question should be placed between the two following: 1 How much water will an 18-inch pipe carry? 2 How long is a rope?

Aside from this, however and on the general grounds of the questions I have seen, I am astonished that Mr Edison should put so high a premium on the acquisition of miscellaneous information, and so very low a premium on understanding, and I think that therein lies the difference between him and the colleges

As I understand it, it is not so much the aim of our scientific and engineering colleges to inculcate knowledge of facts as it is their aim to improve the reasoning, understanding and deductive powers of the student, and I think their aim is the correct one The presumption is that after a young man is graduated from college, he may, without undue effort, learn the port from which most of the washing machines manufactured in the United States happen to hail (and I am not gainsaying that that is an important piece of knowledge); but I think that the young man would have less difficulty in acquiring that knowledge than he would have in learning what is a logarithm I hold he ought to learn about logarithms first Knowledge sufficient to answer most of Mr Edison's questions could readily be acquired by a conscientious study of our Sunday supplements, and I think that the college boys after graduation can be counted upon to apply themselves to those works of reference with great assiduity, but I think none the less, it is inexpedient to concentrate on the Sunday supplements before graduation and I much prefer the present practice, be the results howsoever lamentable in Mr Edison's estimation

I have just jotted down a brief list of questions that I think would fairly canvass the scientific perspective of a new candidate fresh from college, who wants to enter the employ of a great electrician and physicist I think the candiate who answers them satisfactorily would show a quality of understanding and scientific learning that would be a reasonable earnest of success, but I should not expect the young man of 21 years of age, who answered these questions intelligently, to know what country produces the most attar of roses, or what are the ingredients of printer's ink, and the fact that he did not know such things would not lead me to conclude that he was uneducated or unobservant On the contrary, I should say that he was vastly more likely to prove a useful member of society than the man who failed in my examination and passed Mr Edison's. Here are these questions:

1. **Who invented the infinitesimal calculus, and what is it?**
2. **When did Isaac Newton live? State his three laws of motion and the law of gravitation. State them mathematically.**
3. **Who was Michael Faraday? What contribution did he make to the science of electricity?**
4. Who was James Clark Maxwell? What in general was his contribution to electrical research in connection with the work of Faraday?
5. Maxwell summarized Newton's three laws of motion in one brief equation Write it
6. What is a quaternion? Who invented them? What good are they?
7. What is a logarithm?
8. What is the base of the natural system of logarithms?

9 Why do you call it the natural system?

10 How many cube roots has unity?

11 What are they?

12 *What is a hyperbolic function?*

13 What good are they?

14 Why can't you write a formula for the circumference of an ellipse? Or can you?

15 Who was Euclid? When did he live? What was his contribution to geometry? State his famous parallel postulate

16 Who was Lobachewski? Who was Bolyai? About when did they live? Summarize briefly their work in connection with the parallel postulate, and the effect of their discoveries on the development of thought

17 What is meant by non Euclidean Geometry?

18 Who is Michelson? What did his experiments reveal touching the velocity of light?

19 What is simple harmonic motion? Write the equation for it

20 Define entropy

The point of this letter is not in any way to criticise Mr Edison or his examinations, or to propose mine, but to plead that there is a chance for two points of view touching scientific education in our institutions of learning, and to emphasize the danger of drawing general conclusions Thus, I can conceive that Mr Edison himself might fail in my examination and an unthinking person might conclude therefrom that Mr Edison was totally unfitted to conduct modern research in electricity and physics, which would be unfair Just so Mr Edison should remember that a youth prepared to answer my list has very probably spent his time in training his mind, and has not yet begun to stuff it I am one of those who would rather employ a trained mind than a stuffed one, on the general ground that it is easier to stuff than to train Parenthetically, I am not very keen about Mr Edison's stuffing either However, the point is that I happen to have the collegiate point of view and Mr Edison holds the opposite point of view, and it is important that the holders of each point of view should recognize the existence of the other

DeWitt D Barbel

New York.

The Coal Pipe-Line

To the Editor of the Scientific American

In your issue of Feb 12th you publish a proposed scheme for transporting coal through pipes from the mine to the seaboard

This very same scheme was proposed by the undersigned in Feb, 1918 in this country I tried to obtain a patent from the Peruvian Government, but two local engineers, friends of mine unluckily of the same profession, called upon to report on my scheme, knocked it down because such transportation was carried out for short distances hence there was no novelty in applying it for long distances

Coal is very abundant in the interior of Peru—but this interior is between 10,000 and 16,000 feet above the level of the sea and the country between is very rough, so much so that railroad lines cost $25,000 to $50,000 per mile Interest and amortization on a 50 mile line required would be so heavy that the coal placed on the coast could not compete in price with the imported coal

The strike of the coal seams is about north 40 west on both slopes of the main range of the Andes and the seams on the western slope are cut by streams at right angles that reach the coast. There are several coal regions known to me where conditions are ideal for the proposed scheme *i.e*, abundant good coal, comparatively straight valley to the coast, lots of water and difference in level from 10 to 16 thousand feet

Although coal is so abundant in the interior, Peruvian coal is not known in Lima or the coast and it would be a great surprise to 99 per cent of the inhabitants to know that good coal could be obtained in any quantity were it possible to transport it cheaply

The average price of coal before the war was 20 sols ($10 U. S. gold) per ton, during the war and now it is some 170 sols ($85 gold). I calculate that with a capital outlay of some $500,000 for coal mines, pipe line, etc., I could place on the seaboard 1,000 tons per day at a maximum cost of 15 sols per ton, all expenses included.

If the scheme is feasible in the States where cheap railroads, canals, etc abound, where the coal and freights are cheap, much more will it be here where the lowest freight for coal is 3.5 centavos local money per ton-mile, where the railroad line would be nearly exclusively for coal transportation, hence the empty cars would have to be hauled back, where the railroad lines themselves are very expensive and lastly where the coal is very dear on the coast and to be had for nothing in the interior and where no pumping would be necessary

Say that but 1,000 tons were transported 300 days in the year and that these were sold in the form of coal dust briquets, coke or powder and that the average *product was but 25 sols per ton, this with a capital* outlay of some one million sols

R F Letis

Lima, Peru

Spark Plugs

To the Editor of the Scientific American

I beg to differ with the author of the article "Spark Plug Location Important" in your issue of March 19 He says "a plug that becomes heated will tend to soot up and carbonize," etc It has been my experience that the contrary is true I have been in the repair business for eight years and have come in contact with all makes of cars It is true that in racing cars the cooling of the plug is an important item but not one car in a thousand is subjected to the continuous heat which is developed in racing

I have seen aggravated (and likewise aggravating) plug trouble in No 1 cylinder of several four-cylinder cars (anyone who has had experience with them knows what that is) cured by the simple expedient of placing a ½ inch close nipple and pipe coupling in the spark plug hole and screwing the plug in the coupling, thus raising the plug about two inches above the cylinder head where it loses the cooling effect of the water jacket I know the plug becomes hotter because the same plug that fouled was replaced after cleaning the porcelain and the discoloration of the shell noted due to the increased heat

There is at present on the market a device which takes the place of the pipe fittings and is sold in combination with a certain spark plug which is guaranteed not to carbonize, but they do not use the above reason for the non-carbonizing as a selling argument

Also there is manufactured in Newark a spark plug with a corrugated porcelain which protrudes beyond the plug shell into the explosion chamber, the effect being that the porcelain becomes so heated that the carbon does not deposit on it At the same time I have seen the shell, which is in contact with the water jacket, coated with an eighth inch carbon deposit So I believe the theory is correct The only requirements are electrodes that will not burn away and a porcelain which will stand the increased heat At the same time these plugs might not be satisfactory in a racing car or airplane motor We have used several dozen of them with great success in different types of motors

Irvington, N Y L W Smith

A Biological Insurgent

To the Editor of the Scientific American

May I use a little of your space to attack the popular mutation theory I take it that the belief of the mutationists is, that the prime cause of the evolution of species has been the sudden production of large departures from the normal Now it is my belief that not only mutations but many of the minor variations that we observe in plants and animals are by no means original, but are "throwbacks" to types that have otherwise become extinct

A mutation then is the result of either the accumulation of slight variations or of the inheritance of acquired characteristics or both

Every dog breeder knows that an apparently pure stock will occasionally produce what he terms a "throwback" which is breedable while the appearance of idiots among human beings is another example of the same thing Take the historical case of the Scon sheep, a breed which arose from a single short legged ram, born of normal parents on a New Hampshire farm Without doubt some of the remote ancestors of this famous ram were short legged also, but short leggedness being no great advantage in those days they had failed to survive This time they survived because the farmer saw an advantage in a sheep that could not jump a fence

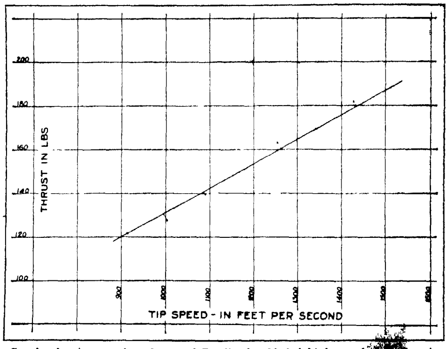
So that this peculiar ability of a type to lie low and to come to the surface at ever increasing intervals (a principle that might be called the suppression of the unadapted) has no doubt played an important part in the evolutionary scheme

H J Smith

Toronto, Canada.

Super-Speed Propellers

Air Propellers With Blade Tip Velocity Above That of Sound



Graph, showing results of test of Reed's thin-bladed high-speed propeller, in which there was a steady increase of thrust as the blade-tip speed rose from 900 to over 1500 feet per second

AIR propellers are rarely driven with a tip speed even as high as 950 feet per second, and there has been a view current among aeronautical engineers that a critical point exists at or near the velocity of sound, say, 1,100 feet per second, which would act as a physical limit and beyond which there would occur something like what is known with marine propellers as cavitation Apparently the only published attempts to explore the region of higher speeds are those which appeared in a paper issued March, 1919, by the British Advisory Committee for Aeronautics, in which a tip speed of 1,180 feet per second was reached with a two-blade nine-foot propeller, when the observation was made that "as the tip speed approaches the velocity of sound the usual air flow entirely breaks down, the slip stream rapidly diminishes, and ultimately vanishes when the velocity of sound is reached Air then appears to be sucked in on both sides of the disk and exhausted at or close behind the periphery, presumably the thrust of the screw under such conditions becomes exceedingly small and may possibly vanish"

Mr S Albert Reed, Ph D a retired engineer, while engaged in 1915 in private research work on acoustic pitch of high frequency, employed an apparatus which had a shaft rotating at over 600 revolutions per second, carrying a hub with radiating arms of thin metal with sharp edges He observed that centrifugal force supplied the necessary rigidity to the arms It then occurred to him that the field of high speeds for air propellers might be explored by a similar method and he proceeded to conduct, systematically, a long series of experiments with propellers 20 inches in length He used a 10-horsepower electric motor of 1150 r p m geared up 12¼ to 1 to the propeller shaft, which therefore rotated at 235 r p s The apparatus was carefully designed to permit accurate measurements of thrust, torque and speed, and he ascertained that the supposed physical limit at the velocity of sound does not exist, but that in fact the ratio of thrust to tip speed undergoes no appreciable variation in passing through that velocity This result was obtained up to a velocity of nearly 1,600 feet per second, beyond which he did not continue his researches for the time being Mr Reed then had his models and testing apparatus reproduced on a working scale capable of absorbing 100 horsepower at the factory of the Curtiss Airplane & Motor Corporation at Garden City, L I and Mr Gilmore, Chief Engineer, placed the tests in charge of their Director of Research Mr Arthur L Thurston, under Mr Reed's direction

17-inch and 22-inch thin-bladed, metal propellers, used in the early experiments of 1915-1916

The Curtiss engineers found Mr Reed's laboratory results fully verified and the accompanying plot and photograph illustrate the test made April 6 1921, with the 4 foot propeller seen in the cut and which reached a tip speed of 1,508 feet per second with a thrust of 186 pounds This is 36 per cent beyond the velocity of sound and is something between the speed of a revolver bullet and that of a rifle bullet

The formula for centrifugal force, if applied, will show that with a propeller of 2 feet radius and a peripheral speed of 1,000 feet per second, 1 ounce will give a radial tension of about 1,000 pounds, and at 1,500 feet per second, about 1 ton. It is evident that a virtual or kinetic rigidity is thus supplied, which may sufficiently replace the structural rigidity of the usual air propeller and make possible a blade sufficiently thin and sharp to function properly at these enormous speeds.

At the ordinary speed of about 600 feet per second, the usual rather bulky and blunt propellers sufficiently meet the conditions, but apparently they are not adapted to the super-speeds, which may be placed as beginning at about 850 feet per second

Test at Curtiss plant, April 6th, 1921, of a 4-foot propeller, which reached a tip speed of 1508 feet per second, with a thrust of 186 pounds

In order to ascertain the efficiency of this type of propeller for actual flying the experiment illustrated in the cuts was repeated under approximately wind tunnel conditions, the wind being supplied by an airplane anchored close in front of the Reed propeller and delivering its slip stream axially down the slip stream of the Reed propellers, the wind velocity being carefully plotted with a Pitot tube, at about 42 miles per hour.

The efficiency factors so determined were found to be high, and a 9-foot propeller of the same design is now nearly ready for testing without gear on an airplane, and both on the ground and flying

Mr. Reed has prepared a paper for one of the scientific societies, giving the details of his researches quite fully, and it will be published in the near future; but there appears to be no doubt that his researches have opened up the field of super-speeds for air propellers, and have proved the non-existence of the supposed physical limit which has to some extent deterred engineers in the design of propellers intended to absorb the horsepower of the very high powered motors. Furthermore, he has opened up interesting possibilities of use with the steam turbine, which operates with extremely high rates of shaft rotation.

Mr Reed informs us that his results will be covered by U. S. and foreign patents.

British Power-Alcohol Research

IT is reported that detailed research is shortly to be undertaken in India with a view to determining the practicability of producing power alcohol on a commercial basis Rice straw and other cheap raw materials which are said to be available in abundance will be used for the purpose of the investigations. Should these experiments in India prove successful, they will be followed by similar undertakings in various other parts of the British Empire

At the same time that these experiments are being conducted, efforts are being made in Great Britain to make possible the ready use of such a substitute fuel whenever it becomes available in sufficient quantities With this object in view, the Empire Motor Fuels Committee of the Imperial Motor Transport Council has recently appointed small technical committees to consider specifically:

(1) The modification of customs and excise regulations pertaining to alcohol;

(2) Experiments for determining the best conditions for developing the alcohol; engine, and types of alcohol fuels, alone or in mixture, for industrial purposes; and

(3) The denaturing of alcohol; *i.e*, rendering it unpotable

The problem of ascertaining what is a suitable denaturant is regarded as of very great importance, and the Empire Motor Fuels Committee (50 Pall Mall, London, S W., 1) has invited in confidence interested members of the public to submit practical suggestions as to possible denaturants. Such proposals will remain the sole property of the individual who furnishes them, and his interests will be properly safeguarded. The special requirements of a satisfactory denaturant, according to the committee, are (1) deterrent taste and smell; (2) non-poisonous; (3) must not be removable at a commercial cost; (4) must be readily detectable in small quantities; (5) must be readily mixable with the spirit; and (6) must be inexpensive.

This affords an excellent opportunity for the practical chemist, albeit it is not such a simple problem as it seems at first reading.

A Multiple Feeder for the Thresher

AN improved type of self-feeder for the grain thresher is shown in the accompanying illustration, which stands for less work for the pitchers and consequently reduces the number of men necessary to keep the machine going. Instead of one long extension feeder running out between the grain stacks or the bundle wagons, two or more short feeders, that can be adjusted as to height and position, are employed. When threshing bundles from the field it is not necessary to drive so close to the machine, and when threshing stacked grain, the feeders can be adjusted to swing out over the stacks and save steps for the pitchers.

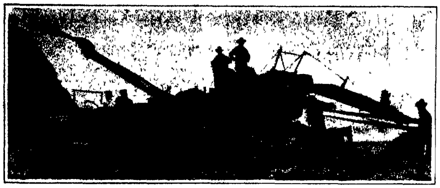
Artificial Frost for Testing Fruit

ANNUALLY, hundreds of carloads of apples, potatoes, citrus fruits, and other products of field and orchard spoil from exposure to freezing temperatures. To determine the points at which small fruits and vegetables can be shipped or stored without being liable to injury, the Horticultural and Pomological Investigations, United States Department of Agriculture, at the Arlington, Va., farm, is employing the electrical method of analysis. Frost injury is likewise included in the scientific study.

By an apparatus equipped by George F. Taylor, Government scientist, twelve freezing determinations are obtained simultaneously, the rapid-fire instruments registering a change in temperature of 1/20 degree within 1/100 of a second. Of course, the reading cannot be accomplished with such lightning-like rapidity. The equipment proper consists of a brine-cooled freezing tank to which are attached 12 cups into which various units of fruits or vegetables may be suspended for making determinations as to freezing. Measurements, ranging from 24 to 72, depending on the character of the products, are made with a potentiometer

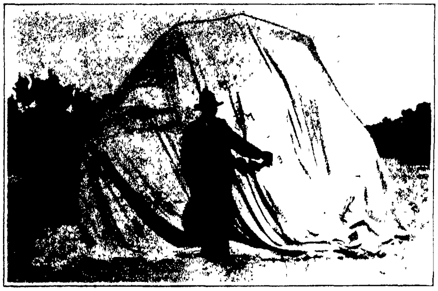
Novel in the Government study of the freezing points of fruits and vegetables is the method of making thermocouples, these being of small size, well insulated, durable, and having a very little lag The couples are made from silk insulated copper and constantin wire As many lengths of each kind of wire as there are to be junctions are cut, about a meter long, assembled together, each end of the bundle slipped through a small, hard glass tube. The ends of the wire are dipped in bakelite to cement the insulation solidly, dried, the insulation burned away for one centimeter, the ends scraped bright and twisted together in pairs, a copper and constantin wire to each pair, for 3 millimeters of the length The couple is then insulated with glass by placing a very small soda glass tube over it and heating in a small flame, the silk covering above the junction being protected At a cherry-red heat the glass softens, and shapes itself to the junction, being completely insulated A like treatment produces the other end of the couple. The diameter is so limited that the multiple-junction couples can be used with smallest fruits with ease, a fifty-junction thermocouple of No. 40 wire being only 2.5 millimeters in diameter.

The temperature is measured by determining the drop in the potential between one terminal maintained in a constant temperature (ice bath), and the other terminal of the unknown temperature in the freezing tank. Twelve readings are made at the same time, the fineness of the measurements being within one ten-thousandth of a degree. The investigations have the threefold purpose of determining the temperature points at which frost injuries occur, devising ways of salvaging injured produce, and methods of protecting fruits and vegetables from damages sustained by low temperatures.



Wing type of self-feeder for the grain thresher, which saves the labor of a number of farm laborers wherever introduced

Apparatus for measuring twelve freezing temperatures. Note galvanometer in upper right-hand corner, and potentiometer and selector switches in center



Canvas bag employed in gassing citrus fruit trees and designed so that the gas does not reach the workmen

Man-drawn plow now being used in France for farming and gardening on a small scale

Water Solubility a Necessary Property of Wood Preservatives

THAT any substance to be an effective wood preservative must be soluble in water at least to the extent of producing a toxic water solution is the basis of a theory now being developed at the U S Forest Products Laboratory It would seem reasonable to expect that any material which is poisonous enough to kill an organism of any kind must necessarily be soluble in the body fluids of that organism, and the chief body fluid of timber-destroying fungi and wood borers is water With very poisonous materials this solubility need not be great, in fact, 1 part in 1,000,000 may be sufficient if the material is poisonous enough

Wood preservatives now in use are of two distinct types—inorganic salts, such as zinc chloride, which are very soluble in water, and oils, such as the creosotes, which are generally considered to be insoluble. The solubility of creosote is usually considered so slight as to be neglected, but experiments indicate that certain constituents of creosote are sufficiently soluble in water to make it poisonous for wood destroyers Creosote oil may, therefore, be considered as consisting of two groups of compounds, one of these being sufficiently soluble in water to render it toxic, the other insoluble in water and hence not toxic The non-toxic oils act as a reservoir for the toxic oils and feed them slowly to the moisture in the wood

The difference between oil preservatives and inorganic salt preservatives, as far as this theory is concerned, is in their method of retaining the reserve supply of poison Zinc chloride has no reserve supply, all the material being soluble in the usual amount of moisture present in air-dry wood Sodium fluoride may have a reserve supply in the form of solid crystals, if applied in a saturated solution Creosote oil may have a considerable reserve supply stored in the oil itself, this supply being fed to the wood as needed.

A Gas Attack on Destructive Bugs

THE deadly fumes of hydrocyanic acid gas are used in eradicating objectionable bugs and fungi from citrus fruit trees As a couple of whiffs of this gas spell sure death to the workmen, great care has to be exercised in treating the trees A graduated scale is so painted on the outside of the canvas bag that is employed for the administering of the gas, and that forms the subject of the accompanying view, as to indicate how much gas is required for any given tree As the canvas bag is placed over a tree the graduated scale indicates the size of the tree, and by subsequent reference to the poison record on the automatic engine which makes and distributes the gas, the attendant can accurately determine exactly how much poison gas to give each tree The treatment occurs in the late afternoon and the canvas bag is wrapped around each tree in turn for a period of forty minutes, which is considered ample time to gas the undesirable bugs and growths

Man-Drawn Plow Work for the Horseless Farmer

THE small truck farmer or gardener can ill afford to employ a horse-drawn plow for preparing his ground, while the use of a spade represents a long and tedious task To the end of simplifying tilling on a small scale, there has recently appeared in France a small man-drawn plow which is depicted in the accompanying illustration A suitable form of harness goes about the arms and shoulders of the man who is to do the pulling of the plow The plow, on the other hand, is so designed that it passes through the soil but a few inches below the surface, the proper distance being maintained by the little roller in front of the blades

The Roger Bacon Manuscript

What It Looks Like, and a Discussion of the Probabilities of Decipherment

TRAVELING through Europe in search of old manuscripts in 1912, Mr Wilfrid Voynich unearthed in a nameless castle of France or Italy an unusual collection, formed by the Dukes of Parma during the eighteenth century and then hidden away for safety's sake, and forgotten He will not tell us where he came upon these treasures, for while he brought some of them away with him he left still more, and he hopes some day to go back for these Among those which he secured on his first trip was the so-called Roger Bacon manuscript which has been so much in the public eye since the Philadelphia lectures announcing its existence

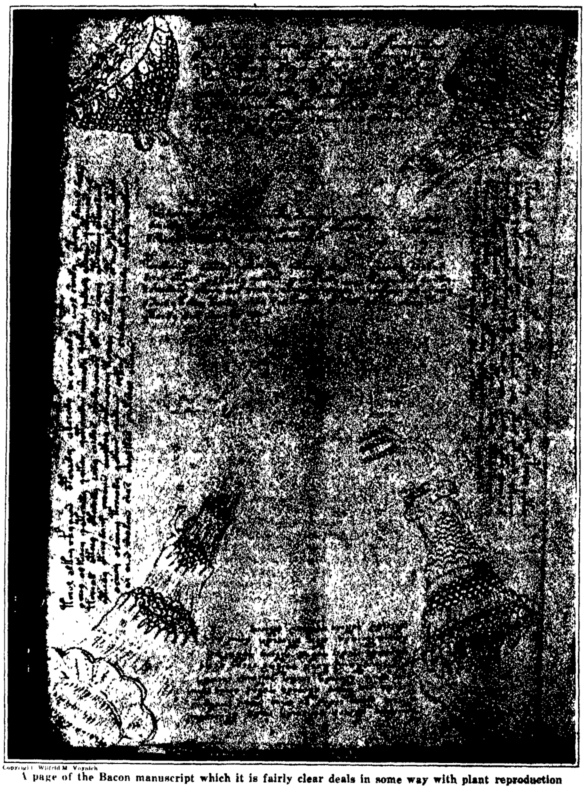
The history of this document as reconstructed by Mr Voynich, and the efforts to decipher it made by Professor Newbold, are fully recounted in the SCIENTIFIC AMERICAN MONTHLY for June As is there stated while it is hardly possible as yet to prove scientifically that the scribe was really Roger Bacon, the very facts the the script is a cipher, that the subject dealt with is certainly of a scientific or pseudo-scientific nature, and that the work may with certainty be dated in the 1300's, suffice to indicate strongly the Baconian origin, while Mr Voynich has succeeded in showing an altogether plausible line of descent for the manuscript and one which would carry it from Oxford to Prag and then to Parma

Our purpose here is not to repeat the historical discussion, or to describe or comment upon the cipher as Professor Newbold claims to have uncovered it We may repeat the opinion set forth by Mr Bird in the MONTHLY, that the evidence in favor of the alleged decipherment is altogether too tenuous to support the claim that the scribe could really have used such an extraordinary and irrational cipher We do not look with patience upon a cipher in the preparation or unraveling of which an arbitrary element enters, and there is no suggestion that this arbitrary element would be rendered systematic by knowledge of a key word or key process But aside from all this, the manuscript is of very great interest, since its Baconian origin rests upon much better ground than the alleged decipherment We therefore supplement the account of it in the MONTHLY with a physical description of the volume itself

The work is on vellum, bound together crudely, aside from a certain amount of dog earing and the inevitable fading of the text, it is in admirable condition, and with the aid of the photostat is readily legible It is obviously a cipher, containing in addition to the ordinary Roman characters a good many other symbols more or less like letters but without direct significance in any language Every page is illustrated, in colors of considerable variety These pictures are crudely drawn in by a person who obviously was somewhat lacking in artistic ability, even for a thirteenth century scribe There is running text on most of the pages, and in addition a good deal of textual matter so positioned with reference to the drawings that it obviously plays in a general way the part of what modern practice knows as captions

The drawings are of two general sorts. A number of the pages are adorned with pictures which are plainly of an astronomical or astrological nature. Even if we had no knowledge of thirteenth century tendencies, we should have no difficulty in intrepreting the astrological features as greatly in excess of the purely astronomical Signs of the zodiac and similar appurtenances abound But these are not usually to be found in the customary arrangement, and much of the astronomical material is actually got up in a form that makes its significance altogether baffling An excellent example of this is to be seen in the right-hand page of the double sheet which we show on the opening page of this issue There appears to be here a central sun; but in place of the twelve divisions into which we should expect the surrounding space to be laid out, we find seventeen The zodiacal signs are absent, and we have plain stars, from one to four in each compartment.

Two of the astronomical pages are of extreme interest in that it is on them that the claims made for the validity of the decipherment rest The left-hand page which we show beside the one just described is not necessarily, on its face, of astronomical character, becoming so with certainty only when we accept the translation of the caption to the central drawing, which is stated to be an account of the scribe's observation of an annular eclipse on a given date of the thirteenth century. On this date, astronomical computation tells, us, there occurred such an eclipse; and with this amount of temptation before us, we can concede that the central drawing might represent an annular eclipse. As a matter of fact, throughout the book the artist has allowed *symbolism to run riot*, and *there is in* no case any satisfactory way of determining just where he means the symbolism to halt and the objective representation to begin. If we make allowance for this, there is no good reason to refuse recognition to this picture as representing the rim of the sun peeping out around the lunar disk.



Copyright Wilfrid M. Voynich

A page of the Bacon manuscript which it is fairly clear deals in some way with plant reproduction

On another page appears a central drawing which several astronomers have easily recognized as bearing adequate resemblance to a spiral nebula—always, of course, making proper allowance for the peculiar style of the artist The text as deciphered tells us that the scribe looked through a refracting mirror—that is to say, a thirteenth century telescope—and saw stars arranged in a pattern like a snail shell, at a point in the heavens which is identified by reference to the girdle of Andromeda and the navel of Pegasus. We do not today show on our star maps the full classical outlines of the constellations, and so the navel and the girdle have to be translated into modern terms before we can plot them, but when we do this we find that the scribe has made a very tolerable approximation to the position of the great nebula of Andromeda To be sure, this doesn't look much like a snail shell, but we may leave that point to be discussed in the MONTHLY.

It goes without saying that many persons will be convinced by these two items That they are not necessarily conclusive is we believe sufficiently set forth in the article in the current MONTHLY, and we shall not duplicate this argument here It is on the basis of the nebula observation that credit is claimed for Bacon for having "invented" or "used" the telescope, sometimes we see one word and sometimes the other. That he was acquainted with the optical principles of the telescope in an empirical fashion is clear enough without this manuscript; that he invented or even used one is hardly clear even with it Certainly he did not invent it, for in his open works he describes it with the statement that he owes his knowledge of it to others The bald statement that he invented it appears in keeping with the reckless manner in which this manuscript has been promulgated.

Apart from the astronomical pictures, the bulk of the manuscript is given over to drawings which appear to be of a biological nature. The artist seems to be interested in the processes of life reproduction, and to be depicting these under a heavy cloak of symbolic representation. Where his subject is animal life, without

(*Continued on page 439*)

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Testing the hardness of a steel twist drill by means of the new hardness tester

A Direct-Reading Hardness Testing Machine

UNLIKE testing machines where the diameter of impression of a certain sized ball is measured after removing the piece being tested to a microscope, the instrument shown above and developed by a New York concern gives the measurement directly on a dial It is intended for use in determining the hardness of steel, brass, copper and some harder alloys

This machine measures the depth of impression of a 1/16-in-diameter ball upon applying a known load to a ball penetrator The size of the ball is such that it is possible to test wire of small diameters also And the light impressing load permits outer surfaces of small tubes having walls as thin as 1/32 inch to be tested without placing a mandrel through the tube

By turning the handwheel the initial pressure is applied until indicator shows pressure is being applied. This makes it certain that the test piece is held to a firm seating and the ball breaks through dirt, scale or other superficial matter The indicator is made to register zero at this point and the major load is released by pressing a push button at the base of the machine When the load is withdrawn the initial pressure is left and the indicator shows the depth of impression made by the major load

The Home-Made Grain Sampler

CONSULT the tinsmith about the availability of a block of tin or brass and construct your own grain sampling device—if you have need for one A design for such a home-made equipment has been patented by the U S Department of Agriculture, the model being dedicated to the use of the public.

The hopper-like instrument is so built that a sample of grain, to be applied in grading a specified lot, can be evenly divided, one half of which specimen can be used as representative of the whole original sample Formerly the sample of a specified lot or shipment of grain was obtained by means of a probe, the specimen being divided into smaller portions for one or more of the tests to be applied in determining its classification This method was considered haphazard in the reduction of the size of the sample and unreliable as to results

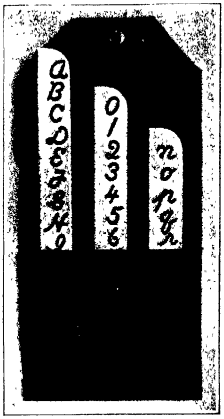
The newly-designed grain sampler is 30 inches high, cylindrical in shape The specimen of grain is poured into a hopper at the top, the emptying of which is accomplished by pulling a lever that removes a cap over the lower end of the hopper As the sample flows downward it strikes the apex of a baffle, in the form of a cone

Encircling the base of this cone are a series of tiny chutes whose distance apart is equal to the width of these openings Half of the grain empties into the chutes, while half passes between them The latter portion flows directly into the uppermost of two pans, placed one above the other at the base of the sampler. The half falling into the chutes is diverted into a funnel, the lower end of which leads to a protected opening in the center of the upper pan, thereby permitting this half of the grain to pass into the lower pan Thus the original specimen is equally divided into two parts, one of which is as representative of the original lot as the other.

Farmers, millers and grain dealers will find this inexpensive apparatus practical for grain grading. The Government is thus endeavoring to popularize Federal grain standards, having previously issued instructions on weighing, moisture determination and the separation of foreign material in grain —*S R Winters*

Phantom view of home-made grain sampler designed by the Department of Agriculture

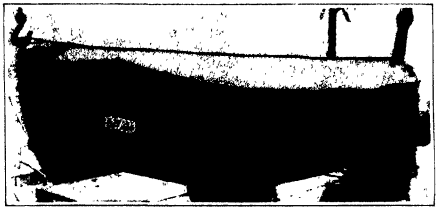
A Simple Aid to Penmanship



Three of the penmanship strips contained in a compact pocketbook

THERE has recently appeared among the many devices and works intended to simplify the acquiring of education, a simple aid to penmanship This device consists of aluminum strips any one of which may be fastened on the edge of a loose piece of paper or the leaves of a blank book, and containing recessed small letters, capital letters or numbers The idea is to have the student trace each letter or numeral with a pencil until a free and easy swing is acquired, and then to shift over on to the paper and write the same letter or numeral until proficiency is gained It is claimed this device has proved quite helpful wherever it has been introduced

Something New in Lifeboats



This lifeboat, provided with a skin of cork and an outer skin of woven cane, is claimed to be safer than the usual construction

THE perfecting of the lifeboat and the means for launching it is certainly a fruitful field of invention On the score of novelty we do not remember anything quite so striking as this so called "basket work" ship's lifeboat which was designed by Mr DeVos of Rotterdam The method of securing additional flotation is decidedly novel and should be effective against complete sinking First a skin of cork is laid on the boat, and over this an outer skin of woven cane Mr DeVos claims that this type of lifeboat is less liable to be crushed should it be swung against the ship's side The resiliency of the cane and cork sheathing should give it a resistance to general damage which will add greatly to its chance of surviving the hazards of shipwreck

A Safe Traffic Signal that is Never in the Way

ANOVEL street traffic signal, shown in the accompanying illustration, was designed to replace the tall, unsightly guide posts which still deface many town and small city streets throughout America Judging by the popularity of the new signal with those motorists who have seen the system in operation at Salina, Kan, it is destined to occupy an important place in the motor traffic regulations within the next few years

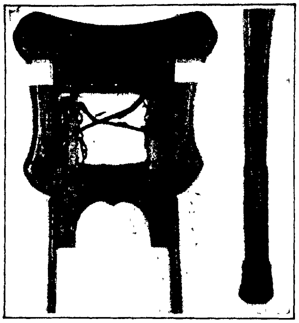
The construction is very simple—180 pounds of concrete molded into a mound two feet in diameter and scarcely seven inches above the street's level at the crown of the signal The white and black sectors painted on the mound render it conspicuous by daylight, and the red lenses placed at right angles so as to face each street from the signal are warning sufficient for night motorists The top of the mound has a square white lens deeply counter-sunk, as are the red lenses in the side

One electric bulb furnishes ample light for all five lenses This is made possible through the use of a metal tunnel which leads from the bulb cavity to each of the red lenses If the bulb burns out, it may be replaced in a few minutes by lifting out the white lens in the top of the mound

A car may turn a bit short and graze the signal, but there is absolutely no danger of an accident which would bring injury to either the signal, car or driver In reality, drivers are inclined to observe the "guide" more conscientiously than they have done with the "tombstone" type

The invention of the signal is attributed to E Buchanan the Street Commissioner of Salina, Kan, in which town it is now in general use

Concrete mound fitted with colored lenses and lights for traffic signals



Top of the shock-absorbing invalid crutch and the sliding tip at the end of the leg

Applying Shock-Absorbers to the Invalids' Crutch

IT has remained for Charles O Mitchel of Hoboken, N J, to invent a simple form of invalid crutch that is provided with a shock-absorber to the end that it will afford elastic support to the user and particularly to his shoulder and arm, thus eliminating the shock incident to impact of the crutch with the ground. This device is claimed to reduce materially the fatigue which rigid crutches are well known to cause A further object is to provide a yielding crutch which may be manufactured at minimum cost and yet possess strength and durability, notwithstanding the fact that it contains moving parts

The manner in which this inventor has accomplished the shock-absorbing feature is shown in the two accompanying illustrations The top of the crutch is provided with a sliding top member, as may be noted in the first illustration This member can be pressed down against two simple springs that cross each other, while simple chains prevent the movable member from being pushed up too far by the springs The end of the crutch leg is provided with a sliding tip, which presses against a helical spring Thus the shocks are taken up at two points We have seen many crutches with springs, moving parts, and other means to get away from rigidity and shock, but this impresses us as the best device of the sort yet exhibited to us

Speeding Up the Shaping of Masts and Spars

THE work of making masts and spars for all classes of vessels appears to have been simplified and materially reduced in cost by an ingenious invention credited to C H Sawyer of Savannah Ga This invention is in the form of a heavy machine shown in the accompanying illustration, which does away with hand labor and turns out a mast or spar in record time Indeed, an ordinary 100-foot mast, 22 inches at the butt, which would require the labor of one man for fully twenty days to complete by present methods, was recently turned out by the Sawyer machine, with all the necessary cuttings for fittings, in less than three hours

The mast and spar shaping machine is known as a rotating plane It is a cross between a lathe and a planer, consisting of a steady rest which grips the stick in the center and rotates it by means of an internal gear driven by a 25-horsepower motor, two carriages that carry the cutting knives, and two tail stocks which support the stick at either end The speed of the steady rest is considerable, while the carriages which hold the cutting blades are propelled from either end toward the center by a track and trolley arrangement at a speed of three, six or twelve lineal feet per minute The knives are two in number, each eight inches long but with a cutting surface of only three inches The accompanying photograph shows the machine in operation

Shaping a "stick" into a mast with a new rotating plane machine

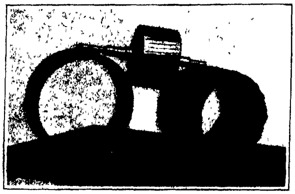
Simplifying the Winding of Small Motors

AN invention, recently patented by Alexander Zarky of Los Angeles, Cal, simplifies the winding of small alternating current motors during their manufacture and even extends their usefulness indefinitely, since it permits of easy rewinding

The invention consists of a removable core in place of the present type of one piece core which cannot be rewound because of its inaccessibility. When this new style core is removed the work may be done expeditiously and in the same manner as is customary with direct current machines, and with preinsulated form-wound coils instead of by hand process.

There is a small loss in efficiency where the two cores fit but the addition of iron at the bridge of the gap in the channel more than covers this, and the prolonged life of the motor because of its rewinding far offsets the slight decrease in current

The new type reduces labor cost in original construction but its chief value lies in its applicability to small or fractional power units.



Components of a new type of alternating current motor that may be readily wound and rewound

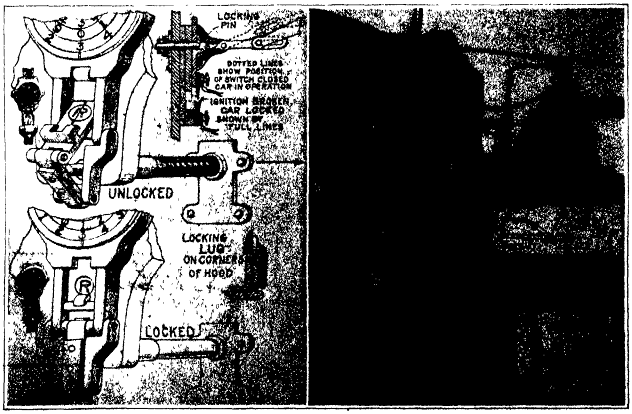
Boys are employed in factories at low wage for the hand-manipulation of the old type of small motors in order to sell them at any profit, while repairs to them after leaving the factories are well-nigh impossible All this will be done away where the new removable core is used, and the salvage in machinery itself is notable. It is reported that the demonstration of the device has astonished and delighted the leading electrical men of California.

An Automobile Lock that Locks

THE object of the invention shown in the accompanying large illustration is to provide a means for securely locking an automobile to prevent theft, joy riding, or the towing of the car against the owner's wishes It consists of a plurality of locking devices within the hood, controlling the hood, carburetor, throttle and electric connections to the engine. These locking members are all controlled and moved simultaneously into a locking position by pressing a foot pedal that passes through the foot-board of the car, and when locked they are kept in that position by a combination lock located on the dash of the car directly in front of the driver To lock the car all that is necessary is to press the foot pedal and spin the combination lock To unlock the mechanism, the combination is set and the lever is lifted

The combination lock has 10,000 combinations which can be changed at the will of the operator When a car is locked, it is impossible to remove the combination lock from the dash without knowing the combination for the reason the bolts that fasten the lock in place are covered and the combination must first be obtained and lock opened before it is possible to remove it To prevent joy riding or the unauthorized use of the car by persons other than the owner, there is a place in the lock to put a small paper disk with the owner's initial on same as shown in the illustration, with the letter "R." Should the lock be opened through some one getting the combination, which is one chance in ten thousand, this disk is broken as shown in view of open lock.

The new device locks a car in eleven different places with one movement of the foot. When this is done, the hood is locked on both sides at the ends and in the middle. The carburetor and throttle are locked and the electric switch controlling the current to the plugs is broken. These are all controlled by the foot pedal and combination lock on the dash as clearly shown in illustrations of same. Another feature of this lock is to stop the theft of parts of the engine while standing in a garage, tampering with the carburetor, etc.


LOCKING PIN
DOTTED LINES SHOW POSITION OF SWITCH CLOSED CAR IN OPERATION
IGNITION BROKEN, CAR LOCKED SHOWN BY FULL LINES
UNLOCKED
LOCKING LUG ON CORNERS OF HOOD
R
LOCKED

Details of the new system for locking the hood and the various members of the automobile power plant to prevent theft

Electric Trains Without Crews

(Continued from page 426)

cels. No trailer cars without motors were used. The main body of the car was placed between the wheels in order to reduce the height as much as possible. The lid of the car opened like that of a trunk, except that it was double hinged and could be opened from either side.

The cars weighed about 900 pounds, empty, including the four-horsepower motor, which was of a special design and shunt-wound, as already stated.

One of the most novel features in connection with this system consisted in the fact that the fields of the motors were excited through their own collector shoes from a conductor rail, entirely independent of that which supplied the current to the armatures. In view of the fact that any momentary interruption of the field current of a motor causes the low resistance armature to act as a short circuit to the line, this separate excitation of the motor field presented a problem to be carefully considered By means of a special collector shoe, however, the difficulty was entirely overcome No short circuiting of the line by the armature ever took place, although the field conductor rail was sometimes heavily coated with rust.

The two conductor rails were placed between the track rails, which served as a common return conductor

The acceleration of the trains was accomplished by providing sections of the armature conductor rail supplied with successively increasing voltage, while the field remained constantly excited at full strength. The braking was similarly accomplished, except that the voltage successively diminished, thus causing the motor to act as a generator and deliver electric energy through the conductor rails back to the power system and in this way exercise a powerful braking effect At the section upon which the train was to stop the armature conductor rail was connected to the tracks, thus closing the armature circuit and continuing the braking effect until the train was brought to rest With this method, the accelerating and braking effect can be readily calculated and the proper length of the sections accurately determined. The braking section can therefore be laid out so as to locate the stopping point whenever desired

In a system to be operated without motormen it is of vital importance to know exactly where the trains will stop and to have them stop in the right places. This would be impossible with any form of friction brakes for two reasons: In the first place, the braking effect is the same regardless of the load; consequently the braking distance is roughly proportional to the load and loaded trains require approximately fifty per cent greater distance in which to come to rest than empty trains. Moreover, variations in the condition of wheels and brake shoes produce a corresponding variation in the coefficient of friction and braking distance. With motor braking, on the other hand, the braking effect is greater for loaded trains than for empty trains, and this self-compensating tendency can be controlled to a nicety so that trains come to rest at the same point regardless of load. In practice the variations were slight

When there are curves of too short a radius to be negotiated at full speed, it is necessary to provide for slowing up the train just as the motorman would do if in control. This is done by providing a braking section before such curves and supplying reduced voltage to the armature conductor rail upon the curve. Upon the Chelmsford line one such curve occurred, as already stated. The trains approached this curve at thirty miles an hour. A short distance from the curve they entered a braking section and were retarded to twenty miles per hour at the entrance to the curve. The best proof of the reliability of electric motor braking is the fact that in three years no accident ever occurred upon this curve, although the calculated derailing speed was twenty-six miles an hour. It is quite certain that no such record could have been made under manual control.

Although the shunt-wound motor has constant speed characteristics and there is little or no tendency for one train to overtake another, it is nevertheless necessary in a system of this kind to provide block sections, if only to prevent trains from arriving at the station more rapidly than they can be unloaded and thus causing rear end collisions at the unloading platform The Chelmsford line was divided into blocks, each train as it passed closing the first block, and opening the second block in the rear The blocks were electrically interlocked so that a closed block could not open until the next succeeding block was closed In reopening, each block would assume a condition suitable for starting a train by progressively increasing voltage if a train were standing upon it at the time, but would go at once to a condition for passing a train over it at full speed if it were unoccupied at the moment of reopening. The control of the blocks was by means of the current flowing to the motor field, the field conductor rail being divided into sections corresponding to the blocks for this purpose Thus there was a complete absence of stops, treadles, or other devices along the track, to be operated mechanically by the trains The first block was at the exit to the station, so that the train would stop within sight of the operator if the line was not clear and move out of the station automatically as soon as the block cleared Upon reaching a station, the trains normally stopped short of the receiving platform, unless and until definitely admitted by the operator

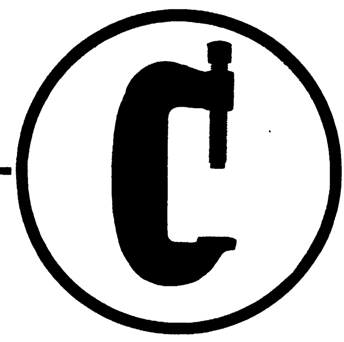
The responsibility for trains and control over them of course passed out of the hands of the operator the moment they left the station The station controllers were interlocked with the block system so that no oversight on the part of the operator could admit a train for which he was unprepared Although the responsibility of the operator ended the moment a train left his station, he could nevertheless follow its progress whether toward or away from his station by means of a diagram of the line placed before him on the control table upon which the positions of the trains were at all times indicated by illuminated sections This indicator system was likewise operated by the field current and by the same relays that operated the blocks

The selective apparatus consisted of a stationary ramp placed alongside the track and a wiping contact upon the train that could be adjusted to make contact or not to do so at any particular station The track switches were operated electro-pneumatically Reversing of the cars in the station for the purpose of backing them off from sidings, etc, was accomplished without reversing switches in the cars and with only *three* connections from the car to the controller, by a novel method which consisted in connecting the field in shunt with a resistance in such a way as to reverse the field.

A trip around the line in one of the cars gave an uncanny sensation of control by an invisible intelligence At the approach to the sharp curve the uninitiated always experienced a lively apprehension of impending disaster, which the car itself seemed to realize just in the nick of time and to avoid only by the most strenuous braking.

The system was inspected by Mr. Herbert Samuel, Postmaster General, and many members of Parliament, also by the French Minister of Posts, in 1912 It was likewise inspected by Mr. Hobhouse when he succeeded Mr. Samuel in 1914 An appropriation of £1,100,000 was voted by Parliament a few months before the war broke out for the construction of 6¼ miles

(Continued on page 437)



A Sure Foundation

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With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

What European Industrialists Are Doing

THERE can no longer be any doubt about the renaissance of the Old World's industry which has taken place in Europe since the Great War. Whether it is due to the serious loss of man-power or to making the acquaintance of some two million young Americans and their way of doing things, or a combination of these two things, the fact remains that European industrialists are rapidly coming around to the modern way of working.

It is a mistake to believe that European manufacturers still employ a preponderance of manual labor in preference to machinery The European laborer has more or less kept relative pace with his American brother in the matter of higher and still higher wages, with the natural consequence that the industrial leader has been forced to consider machinery wherever possible

Thus European factories today employ the last word in transportation systems, such as gasoline and electric tractors and trailers, lift trucks, all kinds of conveyors of the gravity and power driven categories, automatic lathes and other machines, direct and indirect lighting, the so-called "window walls" in which the entire wall is composed of windows, steel shelving and steel furniture wire fences, and so on In fact, we Americans are no longer unique in our employment of such ultra-modern devices, and it is well for us not to rest too long on our past laurels

The European worker has always been a hard worker, but not always so fortunate in the matter of wages as he is today— at least if he is employed today Coupled with his hard work and skill, there is the latest kind of equipment and every labor saving facility that goes to make good work with the least effort It seems very much as though the European industrialists are going to give American manufacturers a stiff fight, using the very tools and methods on which we have always succeeded in the past in holding our own

Saving Fuel with Powdered Coal

THERE is nothing new in the suggestion to employ powdered coal to be sure, but of late the methods of using such fuel have been developed to such an extent that many large users of coal can with considerable profit turn their attention to powdered coal It is claimed by certain manufacturers of powdered coal equipment that a decided gain in steam generating economy with increased boiler capacity follows the more perfect combustion of the lower priced fuels that is obtained by burning powdered coal The higher furnace temperature and simplicity of control with very great flexibility to swing the furnace output with the load makes this established combustion method ideal for the modern industrial plant and central station

According to tests recently performed by two fuel experts with Illinois coal, it is learned that contrary to the customary specifications, it is not necessary to pulverize the coal to the extreme fineness of 85 per cent through a 200-mesh screen in order to obtain good combustion and good efficiency This ability to burn coarser coal means increased capacity of the pulverizing mills and decreased cost of coal preparation The results also show that it is not necessary to dry coal to about 1 per cent moisture in order to burn it successfully in pulverized form, and it is stated that with most eastern coals drying is not at all necessary Good results can be obtained when the coal is burned at rates varying from 0 5 lb to 2 lb. per cubic foot of combustion space per hour, and the best results at a rate of 1 to 1 5 lb

Fortunately for the industrialist who wishes to give some thought to pulverized coal, there are specialists in this field who are prepared to give specifications and costs for the conversion of an existing plant or for the erection of a new plant In either event the pulverized coal idea is no longer an untried one, and it is worthy of serious thought

Electric Furnaces for the Shop

BY leaps and bounds the small electric furnace is coming into general use for the fusion of bronze, babbitt metal and the various alloys of aluminum and bronze The reasons given for the growing popularity of the small electric furnace in this connection are 1 It is economical to operate 2 The metal or alloy that is melted in the closed chamber of such a furnace is kept pure and has greater mechanical strength than is obtained with the usual furnaces 3 The ease with which the electric furnace may be charged, poured and generally handled In Europe, too, the small electric furnace is coming into general use

Avoiding the Flywheel Disaster

AMONG the rare accidents that may happen in a power plant in which engines with large flywheels are employed is the bursting of a flywheel Fortunately, such accidents are a very uncommon occurrence, but the results of a flywheel disaster generally take the form of one or two wrecked buildings, much crumbled and useless equipment, and the taking of several lives Some form of insurance or protection against this event seems worth considering

There has lately been developed an automatic engine stop that is claimed to preclude a flywheel disaster This device, which is really an automatic valve, will automatically cut off the steam flow to the turbines or engines the instant that the speed goes beyond the predetermined limit of absolute safety The assured safety of this device follows the simple rugged construction and the frictionless operation of a gravity actuated, weighted lever and the careful engineering that is back of each installation In addition to shutting down the power unit automatically in case of overspeed, the engineer can instantly stop the unit from any desired point by simply pressing a button or breaking the glass of a hand-stop station

A Metal-Wood Product of Promise

THERE is a genuine novelty about the metal-wood product that has recently made its appearance and that is available for a large number of purposes where an extremely strong yet light, even surface is required The new product consists of two sheets of metal between which is sandwiched a filler of wood The metal flanges are claimed to function like the flanges of an I-beam. The non-metal core spreads steel faces far enough apart to get maximum strength with least weight The product is said to present an even surface like that of furniture panels It is impervious to moisture, will not warp or lose its shape, the hard metal surfaces resist abrasion, and it is surprisingly light Engineering tests of this new product have shown surprising results, among them the fact that the stiffness of a 5/16 inch-thick piece of the new material is equal to five times that of 5/16-inch-thick solid wood panel, or eighty times that of No 19 sheet steel having the same weight The elastic limit in bending of a 5/16-inch-thick piece is reported as 75-inch pounds per inch width, or about five times that of No 19 sheet steel

The new product is furnished from stock in panels, 3/16 inch, ¼-inch and 5/16-inch thick, size 30 by 96 inches, faces of black or galvanized metal No 30 gage, with planed wood veneer cores The weight is from 1 6 to 1 9 pounds per square foot Some of the uses of the new metal wood product are for automobile commercial body panels, portable houses, shipping containers, filing cabinets, lockers, cab roofs, tool chests, car roofs, doors, office furniture, concrete forms, signs, and so on

Keeping the Windows Clean

HERE is a new thought—keep the windows clean Quite obvious, you say, but it is a fact that in many plants the windows are overlooked and gradually accumulate so much dirt and dust that they are no longer windows in fact A thick, hard crust of accumulated grease, rust, soot, scale and dust accumulates on the windows that have not been cleaned at regular intervals, with the result that the plant is obliged to get along on very little light, or artificial illumination is resorted to In either event the results are unfortunate, for after all is said and done, there is no illuminant quite as good as daylight, even if daylight is free

In those instances where the accumulated dirt on windows, skylights and monitors is such that soap and water no longer have any effect on the thick, hard scale, resort may be had to some of the special chemical compounds now on the market which dissolve the most stubborn dirt

Simplifying the Ventilation Problem

YES, we are going to speak about ventilation once more—and perhaps a good many times more in the future, for the reason that it is the one phase of all industrial activities that generally receives very little if any thought, yet means all the difference between efficiency and non-efficiency.

Foul, heavy, odor-laden air slows up the worker no matter how willing he may be and his output varies at least 20 per cent, according to the ventilation of his workroom The 11 o'clock brain fag, the listless waiting for the 5 o'clock whistle, with which every industrial manager is familiar, is due as a rule to lack of fresh air, one of the most vital contributing factors to the efficiency of the worker In the average shop he needs 3,000 cubic feet of fresh air per hour Give it to your employees and you will protect them from tuberculosis, pneumonia and other impure air diseases. So it is argued by industrial engineers, and with very good reason, that the installation of an effective ventilating system will pay the industrial manager generous dividends for years to come

A natural draft ventilating system is the most economical and effective where it is possible to install ventilators that give positive, constant ventilation. An American manufacturer has recently introduced a suction ventilator that is claimed to exhaust more air, heavy fumes, or steam, per dollar of cost, than any other system. This is a big statement, no doubt, but the design is quite novel and appears to be radically different Briefly, the new ventilator has a line of exhaust that is above the horizontal, the discharged air has easy upward course, and the suction force of the outside air rushing in through the cone-shaped suction tube, which is kept in allinement with the air current at all times, has no sharp angles or obstructions to lessen its power, and acts as a strong siphon, drawing the impure air up and out The ventilator is said to be storm proof, dust-proof and requires no attention Its first cost is the only one

Extinguishing the Factory Fire

PRACTICALLY every fire can be extinguished within the first five minutes if proper equipment is brought into use, by men who know how to use it, according to the National Safety Council Successful extinguishment of fire does not, in general, require elaborate, expensive equipment, the essentials are the right kind of equipment suited to the existing hazards, kept in good condition and located in the right place, with men who know how to use it, and that it be brought into use immediately after the fire starts

The principal reason for extinguishing fires is to prevent property loss Nevertheless, it is also of vital importance for the protection of life Even in well-constructed buildings, with ample exits, a fire which is allowed to spread may cause panic and injury if not loss of life In buildings of inferior construction, with substandard exits, the safety of the occupants demands the most careful attention to fire-extinguishing facilities, as well as to fire alarms and drills and to fire prevention

No matter how well equipped your plant is with fire-fighting apparatus, nor how well trained your men may be to handle this apparatus, it is of utmost importance that the public fire department be notified immediately when fire is discovered, in addition to your efforts with private equipment. When men rely wholly upon their own ability to extinguish small fires, serious losses often result which could have been prevented had the public fire department been notified promptly.

There can be no gainsaying that auto-

(*Continued on page 440*)

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Electric Trains Without Crews

(*Continued from page 435*)

of automatic electric railway connecting eight of the most important post offices in London. The tunnel was completed during the war The contract for installation of the electrical equipment has been postponed on account of high prices The London system will consist of a circular cast iron lined tunnel nine feet in diameter, accommodating two tracks with a gage of two feet, and the cars will be about ten feet long, five feet high and three feet wide, or considerably larger than the Chelmsford cars, although they are of the same general type The specifications call for a direct-current system, operated by shunt-wound motors with field excitation from a separate conductor rail, and a line divided into blocks, with control in the station vested in an operator in a control cabin, all of which features characterized the Chelmsford system

Molasses for Fuel

(*Continued from page 427*)

separation of the crystals from the molasses by whirling it rapidly in a machine described as centrifugal The mechanism consists of a perforated basket, revolving inside an iron casing The basket is lined with finely perforated sheet bronze or with woven wire cloth measuring from 14 to 24 inches in depth and from 30 to 40 inches in diameter

Revolving at a speed of from 1,000 to 1,400 revolutions a minute, the molasses is forced out through fine openings caught in the iron casing and conveyed away in a conduit The sugar crystals are retained in the basket, the latter being subject to spinning activity until the sugar is divorced from the molasses. The sugar is in a raw state, crystalline but lumpy, and due to impurities varies in color from a light tan to a dark brown The molasses, carried off in the conduit, is boiled again and replaced in the machine for another offering of crystals, classified as "molasses sugar" The molasses, in its final form, was once marketed for the manufacture of rum, spirituous liquors, or alcohol Limited use was made of blackstrap as a stock food or fertilizer, but its conversion into whiskey was its chief application

The raw sugar, unfit for consumption as it comes from the centrifugal machine, is refined by first dissolving in hot water and the resultant liquor filtered through cotton bags as a method of removing insoluble impurities Succeeding this process, the product is subjected to iron cylinders packed with charred bones, charcoal evidencing a strange affection for the soluble impurities After filtration, the purified, colorless liquid sugar is boiled in vacuum pans, refilled as evaporation sets in, until the crystals have begun to reform, when the mass is again spun in the machines which separate the liquor from the crystals, according to the process previously described. These crystals, once having dried in horizontal cylinders, fit the description of the granulated sugar which we buy at the corner grocery store Soft white sugar is the product of staying the process after passing through the centrifugals The granulated product is obtained by controlling the crystallization in a granulator and by sieve grading Loaf sugar is the result of diverting the mass formation as it comes from the vacuum fans into molds, where it drains and then placing the molds into ovens to be solidified Pressed cubes are shaped from moistened granulated sugar Strange anomaly, sugar in the process of formation is tested for quality by the way in which it refracts light rather than by its taste for sweetness

The final residue is molasses, which is to be profitably utilized as fuel, and commercial potash by the chemical and mechanical process already indicated. Commercial potash is now commanding from

(*Continued on page 439*)

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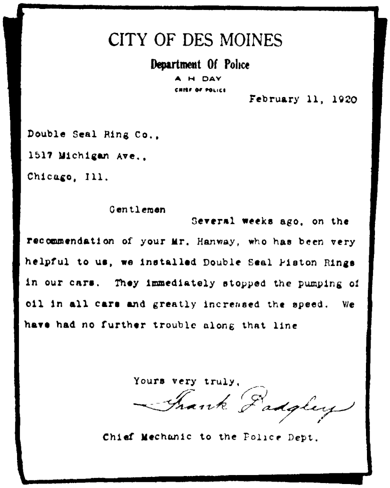

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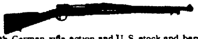

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Recently Patented Inventions

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Of General Interest

TIE PRESS AND HOLDER—N M DYER, c/o U S Customs Ferry, Wash An object of this invention is to provide a portable device which can be conveniently carried in the handbag of a traveler, *and* which will operate *to* hold any *number* of ties and exert sufficient pressure on the ties so as to smooth out the wrinkles A further object is to provide such a holder as can be cheaply manufactured

CLOSURE FOR CONTAINERS — M D FINK, c/o Dwight P Robinson Co 125 E 46th St, New York, N Y It is the principal object of the invention to provide a construction for the delivery and of a collapsible tube by providing a closure which forms a *permanent* part *of the* delivery *end of the container* Another object is to provide means adapted to coact with the container neck to retain the closure in sealed contact when the closure is disposed over the delivery opening

PLANT STAND—D F LOUDON, 109 W 102nd St, New York, N Y The object is to provide a plant stand for use in the house, in florists' windows and other places and arranged for holding and displaying potted plants at various angles relative to the light Another object is to allow the user to turn the pot holder while in an *inclined or angular position, to insure the proper uniform* dropping of the stems and flowers without requiring changing the pot in the holder

DEVICE FOR HOLDING PRECIOUS STONES—A J BENJAMINS, 543 4th St, Brooklyn, N Y This invention relates to an apparatus used in connection with the cutting of precious stones The principal object is the provision of a device for holding stones with which a gage for determining the correct axle of the facets may be used without *the necessity of removing the same there from* A further *object* is to provide a holder which will accommodate gems of various sizes without the necessity of changing the equipment

MOTION PICTURE REEL AND CONTAINER THEREFOR—H HUMMELL, I W MARTIN and C J SCHWALL, address Harry Hummell, 12 75th St, Woodhaven, L I, N Y The primary object of the invention is to so construct a film reel that it may be used as one section of a reel container for the purpose of storing the film when not in use A further object is to so construct the container that it will be *fire proof, and* that a number *of* the *containers may* be suitably secured together to facilitate transportation

SKIRT MARKER—F W SIMON 940 Leavenworth St San Francisco, Cal The invention has reference more particularly to a device for gaging and marking the length of the skirt so that an even hem may be produced The primary object is to provide a device which may be conveniently and effectively manipulated by the person wearing the skirt without *soliciting the aid of some one to realize the desired results*

CLIP FOR CLOSING NON METALLIC COLLAPSIBLE TUBES—R A BACHMANN c/o Sanitube Co, Newport, R I The invention has for its object to provide a clip for use in closing non metallic collapsible tubes which has pins serving to hold the tube in position when rolled The clip is so constructed that when applied and the tube is rolled up tight the tube will remain in this position until it is unrolled manually

CLOTHESPIN—Z FONVILLE, c/o Carolina Wash Board Co Haggett and Snow Sts, Raleigh, N C The *object of the device* is to provide a *spring bridle of simple construction by means* of which the jaw members are held in clamping relation The pin comprises a pair of jaws, a wire bridle with ends secured including a single strand between the jaws, forming a fulcrum and exerting spring tension when the jaws are open and said strand is put under a torsional strain

DIVER'S SUIT—H HOUDINI, 278 W 113th St, New York, N Y Among the objects of the invention is to provide which the diver may put on or take off without requiring assistance, the suit being so arranged as to permit the diver, in case of danger, to quickly divest himself of the suit while being submerged and to safely escape and reach the surface of the water Another object is to prevent the diver when submerged from being crushed by *the* pressure *of* the surrounding water in case the air supply gives out or the air line becomes fouled from any cause

PROCESS OF MAKING RECEPTACLE CLOSURES—A L BERNARDIN and G P PFIERMAN, Evansville, Ind The invention relates to a process of manufacturing closures for receptacles such as bottles with a lacquered sheet without endangering the lacquered surface An object is the provision of a process in which the cylinder and its cap, making up the complete closure, are joined by pressure *applied lengthwise* of the cylinder and *thus avoiding lateral* pressure and the danger *of mutilating the cylinder*

METHOD OF MAKING TUBES—R. W LOWE c/o Conn Brass Corp, West Cheshire, Conn Among the objects of the invention is the provision of a method of making tubes in which a clogging and bending of the parts will be eliminated, and the delay incident to cleaning the same will consequently be avoided, also the objection incident to utilization of a billet, which is circular in cross section, is avoided

ASSORTING TRAY—W S. SHEPPARD, Box 416 Colorado Springs, Colo. The general object of the invention is to provide a tray for papers of *various* kinds, and particularly to *the maintenance of checks,* deposit slips and the like in ordinary files during posting, thereby increasing the efficiency while lowering the possibility of error in posting to the wrong account It is a purpose to provide a tray which is of simple and inexpensive construction

BED—J P DIECKMANN, Route 2, Oakfield, Wis An object is to provide a bed which will give readily with the weight of an occupant A *further* object is to provide a bed in which *the spring and mattress* instead of being supported upon the side bars of a bed *frame* are supported on a frame suspended from a cross bar attached to the head and foot pieces of the stationary bed frame

DIAPHRAGM FOR PHOTOGRAPHIC LENSES—G W COOPER, Shaftesbury Hotel, Great St Andrews St, Shaftesbury Ave, London, England The invention particularly refers to diaphragms of the kind provided for the purpose of obtaining stereostopic or relief effects by means of superposed images The object is to enable artistic effects to be readily obtained, which effects have hitherto been produced only imperfectly either by a combination of lenses or by means of a gauze cap placed over the lenses

PHOTOGRAPHIC FILM SEALER—V ST C BRACKETT, Liberty Block, Moncton, N B, Canada This invention has for an object to provide a construction which will seal the exposed film before removing the back of the camera containing the film. A more specific object is the provision of an adhesive strip arranged to overlap part of the body of the film together with a tearing member connected so as to cause the adhesive member to move to an opposite position when the film has been completely rolled after exposure

HANDBAG HANDLE—H. E WALTER, 729 28th St, Oakland Cal This invention relates particularly to that form of handle which comprises two members and is commonly known as a split handle It is the object of the invention to provide means for removably locking the two handle members of a split handle together by a fastener which may be readily attached which will be practical and *will not increase the cost of the bag*

FLOORING—S. HEDGES, 4607 Welsh Place, Los Angeles Cal The invention has for its object to provide *a* veneer flooring having *a* tongue and groove joint simple to form, and easy to put together and which shall, under all conditions produce a smooth surface, and which will provide a great saving in the first cost of the flooring

DISPLAY DEVICE—S. M BENJAMIN, 302 W 22nd St, New York, N Y An object of the invention is to provide means for supporting and moving a form on which dresses, coats and other garments are supported so that the *garments can be effectually displayed from the front, back and the sides* in show windows to attract attention A further object is to provide a construction of track and a car for the support of the form, and an electric motor.

CENTERBOARD.—F. A. GRAHAM, Harbor Springs, Mich The invention relates to sailing vessels, and has for its object the provision of a centerboard which is made of fabric which can be folded to occupy a minimum space in the boat A further object is to provide a centerboard which may be cheaply constructed and may be operated from the stern of the vessel without leaving the rudder

ADVERTISING DEVICE — C. GARCILLAN, address B La Hoyas, 90 Nassau St., New York, N Y It is the primary object of the invention to so construct a sign, of the interchangeable *letter type,* that the several letters *thereof may be* placed in display position and removed at will. It is a further object to so construct a letter supporting means that plates of various sizes may be used in connection therewith.

PAINT—H N WELLS, 1207 Willow Ave., Hoboken, N J An object of the invention is to provide a paint which serves as a substitute for what is known as "rubber paint" and which will effectively cover oily or greasy surfaces A further object is to provide a paint which *may* be used in connection with *sound proof* material as a covering therefor. The paint comprises the following ingredients· Soap, 9 ounces, whiting, 2½ pounds, lime 28¼ pounds, salt, 1¼ pounds, water, 4 gallons; to which is added coloring medium

DEVIASCOPE—S A ELLINGS, 8704 20th Ave, S W, Seattle, Wash This invention relates more particularly to a device which is designed for use by students of navigation as a medium for illustrating compass deviation due to lines of magnetic force in a ship, particularly a steel ship, and also illustrating the *manner of correcting* such deviation through the employment of ordinary *means* on the ship.

Machines and Mechanical Devices

APPARATUS FOR PULLING PLIES OR THE LIKE—J A PURVIS and H A SESSIONS, 216 W 10th St, Traverse City, Mich The invention has for its object to provide an apparatus for pulling plies or the like, and relates more particularly to a machine designed *for pulling plies of fabric from old pneumatic* tires, to be used as reliners and patches in vulcanizing work With this device a tire may be quickly stripped, and with but little labor.

SAFETY ATTACHMENT FOR THE SUCTION PIPES OF CENTRIFUGAL PUMPS—J C HOOKE, address W J Bacon, 54 Goodbar Bldg, Memphis, Tenn The invention relates more particularly to safety devices, the object being the automatic relief of back pressure or water hammer in case of clogging of the suction head, *to prevent pump destruction,* and a further object is the provision of a device which will allow of external connection of a priming device with respect to the pump casing

CHANGE SPEED GEARING—W W. WILSON and J L PERRY, R F D No 2, San Luis Obispo, Cal The object of the invention is to provide a change speed gearing especially adapted for use in connection with the standard plunger drive mechanism of well pumps and which is effective to double the frequency *of the stroke or linear* speed *of* the pump plunger over that *normally imparted* thereto whenever conditions make it desirable for a relatively high rate of plunger reciprocation.

CONTROL HEAD FOR OIL WELLS—D BREEDING, address Nelson & Blair, 208 Security Bldg, Tulsa, Okla The invention relates generally to apparatus used in the drilling of oil wells, and particularly to a control head, a purpose being the provision of a control head which permits the application and removal of the oil *sealing* device while the drilling tools *and cables* are suspended within the well without permitting the escapement of oil from the head

BARREL PRESS.—J. A. COHILL, Hancock, Md This invention has for its object to provide a device especially adapted for placing the heads in filled barrels of potatoes or the like wherein a fluid pressure controlled plunger is provided upon which the barrel is placed, the said plunger being at the floor level, and wherein the controlling mechanism causes the plunger to move *upwardly* to lift the barrel *into* contact with a fixed abutment to force the head into place.

MARKING MACHINE.—C. E. LARSEN, 3620 W. Division St., Chicago, Ill. An object of the invention is to provide a device which can be operated manually, having means for accurately, expeditiously, and effectively marking a desired pattern upon cloth, or the like, whereby a great saving of time and labor results, and by means of which provision is made for a change of pattern at will.

VIBRATING MOTOR.—K. EDISON, Spring Valley, N. Y. Among the objects of the invention is to produce a motor which may be adapted for use as a source of power for operating figure toys. A further object is the construction of a motor which will operate efficiently while extending in either an upright *or downward position,* and a pawl mechanism which may be relied upon so that the breakage of the spring due to backlashing is entirely precluded.

Pertaining to Vehicles

REFLECTING DEVICE FOR AUTOMOBILES—H. B DAVIDSON, 3206 N 29th St., Tacoma, Wash. An object of the invention is *to provide means whereby* the driver of an automobile *may obtain* a perfect *view* of the road to the rear of the car from the driving seat without taking his eyes from the front of the car. Another object is to produce a reflector by means of whihch the driver can obtain a rear view or view at any lateral angle.

TRAFFIC SIGNAL.—A. N. MENDELSON, 267 W. 143rd St., New York, N Y. The invention has particular reference to a directional indicator for automobiles or other road vehicles, particularly *large motor trucks* A further object is to provide a device which may be manufactured at a minimum expense in a standard size and which is readily adjustable to vehicles of various widths.

TRACTOR.—VAN V. ABEL, Waco, Texas The object of the invention is to provide a device of the character specified wherein the propelling force is delivered through tractor blocks which are swung in succession into and out of engaging position with the ground, to advance the tractor, each block is provided with a toothed undersurface to secure a firm grip upon the ground

TIRE HOLDER.—R. C. MONTGOMERY, 183 Monroe St, Brooklyn, N. Y. An object in view is to provide a holder which may be fastened rigidly to certain parts of an automobile, or adjustably connected to a permanent rim carrying wheel or fixture. A further object is to provide a holder wherein the carrying arms are radially movable so as to snugly fit into a tire carrying rim and to properly fit demountable rims carrying tires

SPEED CHANGING MECHANISM.—O HILL, 811 E Jefferson St., Crawfordsville, Ind It is a purpose of the invention to provide a *speed changing mechanism* for motor vehicles in which the *necessity* of shifting the gears to secure the various speeds is eliminated, thereby preventing the possibility of dripping the gears and dispensing with the usual objectionable noise incident to the shifting operation,

TIRE FASTENER.—A O. KUNERT, c/o T. H MCENROE, 1 and 2 Kennedy, Fargo, N D The invention has for its object to provide a fastener wherein a sectional rim is provided, consisting of sections slidable upon each other and having interengaging *means for* constraining them when *they are moved* circumferentially with respect to each other, to cause them to grasp the holding beads of the tire or to release the same, and wherein means is provided for moving the said sections in either direction, and for locking them against reverse movement.

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Molasses for Fuel

(*Continued from page 437*)

$250 to $360 a ton, whereas the pre-war figures were only $75 a ton During the World War as high as $1,000 was paid for a single ton Not only agriculture places demands upon available potash sources, but the product is used in the manufacture of chemicals and soaps The possibility of obtaining 150 pounds of potash from every ton of blackstrap molasses may ultimately relieve the stringent demands placed upon Alsace-Lorraine and Germany, premier potash-producing regions of the world. The commerce carrying cargoes that ply between Cuba and the United States, bearing barrels of sugar, may alternate the burdens of their consignments to read, "Potash from the sugar manufacturing establishments, thanks to mechanical ingenuity and the variable uses of blackstrap molasses"

The Roger Bacon Manuscript

(*Continued from page 432*)

exception he conceives the reproduction processes as under the beneficent direction of certain intelligences which Professor Newbold aptly describes as "the little life-giving spirits" The drawings are full of these spirits, represented as female figures, some naked and others clothed, but all possessing the fat and tubby lines of the kewpie. If full credit be given the scribe for all the objective representations which Professor Newbold believes the drawings to contain, these spirits are represented as guiding the sperm, the ovum, etc, in their careers, as conducting the individual spirits from heaven to the bodies which they are to occupy, etc, etc. On this page we reproduce a representative bit of the manuscript dealing with the phenomena of plant life, those in which the subject is animal reproduction are hardly suitable for general circulation and are therefore omitted.

It is on these drawings that opinion splits widest Taken without consideration of any text which might or might not be offered with them, they might mean everything or nothing The scribe was not a great success as an artist, his efforts sometimes remind us of the crude outlines which we produce in impressing upon the draftsman what we want and how we want it On the other hand, it is quite plain that the drawings do possess some symbolic significance, and the question arises of where the symbolism halts and objective representation begins Professor Newbold claims without reserve that we have here an attempt to picture with considerable objective detail, the microscopic structure and processes of sperm, ovum and embryo, of pollen and seed

Dr Clarence McClung, University of Pennsylvania embryologist states boldly that he cannot follow this argument To a group of nine rather large drawings on a folded insert in the manuscript, which Professor Newbold believes to be micro-drawings of as many successive states of the human embryo and its surroundings, Dr McClung considers it impossible to assign any objective meaning at all save perhaps in two instances, and in these he is very cautious Admitting the difficulty of disentangling symbolism and objectivism, Dr McClung is unable to find anything in these drawings which impresses him as a good representation of natural structures or processes He states categorically that if they are admitted to be what Professor Newbold would have them, they would involve better observation than could be made with the naked eye, but probably would call only for the use of a simple magnifying lens. Again the coupling of Bacon's name with the microscope is rebuked.

It really seems that at times Professor Newbold allows his wishes to run riot with his better judgment. On one page

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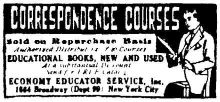
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he finds, wandering down the border for a distance of several inches, a long, thin thing which we should never, on our own initiative suppose to be anything other than a conventional border ornament If it were insisted that we find an objective representation for it, we should say that it looks more like the uncoiled end of a roll of ribbon than anything else—there is the merest suggestion of form to the end, but certainly not enough to make this end pass for the head of an earthworm, let alone of a sperm Yet Professor Newbold makes the categorical statement that it is a sperm, and that biologists to whom it has been exhibited have unreservedly pronounced it to be a sperm. Dr McClung's comments on this item may be epitomized in the statement that he mentions it with an indulgent smile We should be inclined to smile with him, but more broadly.

The most liberal estimate that we are able to make of the objective side of the biological drawings, as a whole, is that they show nothing that is not known to every layman today, nothing which we can conceive as unknown to any anatomist of Bacon's time, little enough which the mere survival of the species, coupled with our knowledge of medieval morals, does not demonstrate always to have been known to the race at large. Presented in connection with a thirteenth century textbook we might then be inclined to admit them

In connection with a thirteenth-century exposition of new knowledge of such startling and unorthodox character that it had to be hidden beneath a six-fold cipher with two arbitrary processes of guess-work in its solution, we do not see that they can possibly be of the significance which is attributed to them We should greatly prefer to interpret them as part of the statement of some secret, unorthodox ritual and creed, which there would be mighty good reason for concealing from the authorities with as many layers of cipher as the scribe's imagination would permit In such connection the very features which prove now most puzzling would become the most significant, and the biological pages of the work would present a much more harmonious whole with the astrological sections

Nor are we able to follow Professor Newbold in his opinion that such passages as he has presented in deciphered form are with plausibility assignable to Bacon While Bacon was centuries ahead of his own time in scientific ability, he was after all of the thirteenth century and subject to the fundamentals of that century We know that he was an astrologer and an alchemist and a churchman; in all these things we may be confident that he was not a step ahead of his time—we may find ample evidence to justify this conviction His leaning toward experiment as a substitute for the dicta of Aristotle was his sole weakness, measured in terms of contemporary opinion So we must not expect too much from him; and the drawings, assuming them to be his, show rather plainly that we are not getting too much

On the face of this, Professor Newbold offers the following translation in connection with one of the biological drawings: "Here the souls are growing and extending themselves You see the essential aggregations of the sacks (*i.e.*, cells) are being severed into bonds between the kernel and the fragile membrane of the egg, but there are arising points between the external masses of cells at that point" This we recognize as an effort to state present day knowledge of reproduction by fission without the facilities of the present-day vocabulary

Our feeling is without reserve against the possibility of such a passage in Bacon It will be noted that this description is not of mere microscopic structure, etc, which any novitiate of decent intelligence with a decent glass might fairly be expected to get reasonably correct. We see described here, with an approach to accuracy, processes which the most brilliant scientist could hardly interpret without a vast number of independent observations upon different stages of the processes described, and upon many different species With the background of this character provided him today, an amateur scientist could readily make the generalizations that are made in this bit of text, without this background we do not see how a Bacon could be expected to make them, or a Darwin or a Haeckel. Even as an inspired guess like that of Democritus on the atom, we cannot swallow it. Our only conclusion is that modern knowledge has been read into this passage and others like it.

The judgment that this manuscript really is a Baconian one impresses us as inherently reasonable and as adequately supported by investigation. The translation offered impresses us as altogether unreasonable, both as regards the character of the cipher and the nature of the translated passages Moreover, on Professor Newbold's own statement the cipher is so difficult that a preliminary impression of what the picture is about usually makes all the difference between success and failure in deciphering the text. As he throws page after page upon the screen, one gets so accustomed to association of the statements "I have not been able to decide what this picture is intended to mean" and "As yet it has not been possible to make anything out of this text," that any deviation from this association would stand out like a sore thumb Let the translator decide what the picture is about, and he can produce a text which shall be about the same thing; otherwise he appears helpless Until enough of the pages are deciphered without reference to the pictures, and found to give meaning to these, we must regard the *a priori* decision as to what the text is about as an essential feature of the "decipherment." This decision, coupled with the arbitrary steps in the translation, certainly robs the work of any slightest claim to scientific precision A single arbitrary step in a cipher has been shown to make it almost a mathematical certainty that it can be made to say anything whatever, and Professor Newbold's procedure involves two such steps, coupled with a decision as to what it is desired that the cipher shall say As a basis for further investigation his work may be of value; as anything more than this we do not see how it can stand.

Extinguishing the Factory Fire

(*Continued from page 436*)

matic fire extinguishers, such as sprinkler systems, are the best kind of protection for the very reason that they are automatic They operate whether someone is on the premises or not, in the event of fire However a reliable water supply of ample capacity and pressure is essential for efficient fire extinguishment Sprinkler systems and hose lines are valueless unless an ample supply of water under pressure can be maintained for an appreciable length of time.

The city line or water works connection, according to the National Safety Council, probably constitutes the most satisfactory source of supply where the plant is so located that such a connection is possible Many plants have in addition a private source of supply, while others must depend entirely upon their private supply This is provided from large reservoirs, elevated tanks, or a pump drawing from a stream or reservoir.

There are three general types of sprinkler systems in use: The wet system, the dry system, and the open system. In the wet sprinkler system the water (under pressure) stands in the sprinkler pipes continuously, and when a head melts, water is sprayed over the surrounding area. Where this system is used the building must be heated throughout the winter months. For unheated buildings, where [illegible] temperature would [illegible] below freezing, the dry system is nec[illegible]y. In the dry sprinkler [illegible] air under pressure—20 [illegible] any release of this a[illegible] automatically admit w[illegible] through a dry-pipe v[illegible] in a heated valve room. The [illegible] valve is so constructed the[illegible]atively low air pressure will [illegible]old a water pressure two or three times as great.

The open sprinkler systems, though not in general use, are of some advantage for distributing water over the roof or sides of a building, and over wired-glass windows or steel shutters to afford protection against fire in an adjoining building. They are non-automatic in action, it being necessary to open a valve admitting the water supply to the sprinkler pipes which are located in readily accessible places on the outside of the building.

It is interesting to note that sprinkler heads are made in four different ratings which have melting points ranging from 160 to 360 degrees. The heads with a higher melting point are made for use in dry rooms, boiler rooms, and other places where a high temperature prevails and where heads of a lower melting point cannot be used. Care should be exercised, on renewing heads in such locations, that a head of proper rating is used. Heads of as low test as one can safely stand should be used, for the lower the melting point of the head the greater the degree of protection afforded by the sprinklers.

While fire pails and fire barrels may be provided at very low cost and have the advantage that their use is understood by all, there are certain disadvantages in their use, such as (a) difficulty of always keeping the barrels and pails full of water, (b) preventing their use for other than fire purposes, (c) a limited range and accuracy in the use of the fire pail, (d) the impossibility of reaching fires which may develop behind sheathing, within flues, or on overhead construction or ceiling.

Hand extinguishers, on the other hand, have a fairly good range, are easily maintained, are not likely to be used except for fire purposes, and throw a stream containing gas, which has exceptional fire extinguishing qualities. The possible disadvantages of extinguishers are that they cost somewhat more than fire pails and their operation is not always understood Several types of extinguishers have been developed, the most notable of which are those which use as the extinguishing agent (a) the soda-acid solution, (b) carbon tetrachloride, and (c) a foam solution.

In purchasing extinguishers it is recommended that those bearing the label of Underwriters' Laboratories be given preference.

The soda-acid extinguisher in common use employs a solution of about a pound and a half of bicarbonate of soda to two and a half gallons of water, with an inner container of approximately four ounces of sulfuric acid. These are made in the "loose stopple" and the "break bottle" types. The latter are especially adapted for railroad and boat service where the swaying and rocking would splash the acid over into the soda solution thus rendering it useless. By inverting the extinguisher, or breaking the bottle (see directions on extinguishers), the acid is emptied into the soda solution, forming a gas the expansion of which forces out the solution under considerable pressure.

These extinguishers are valuable in free-burning fires wh[illegible] is much draught. They are also of value in fighting [illegible] ceilings or between walls where it cannot be reached by fire pails. Sizes larger than two and one-half gallons' capacity are not recommended because of the inconvenience in handling. In schools [illegible] and other places where women [illegible]dren may be called upon to [illegible], even a one and one-half [illegible] is recommended.

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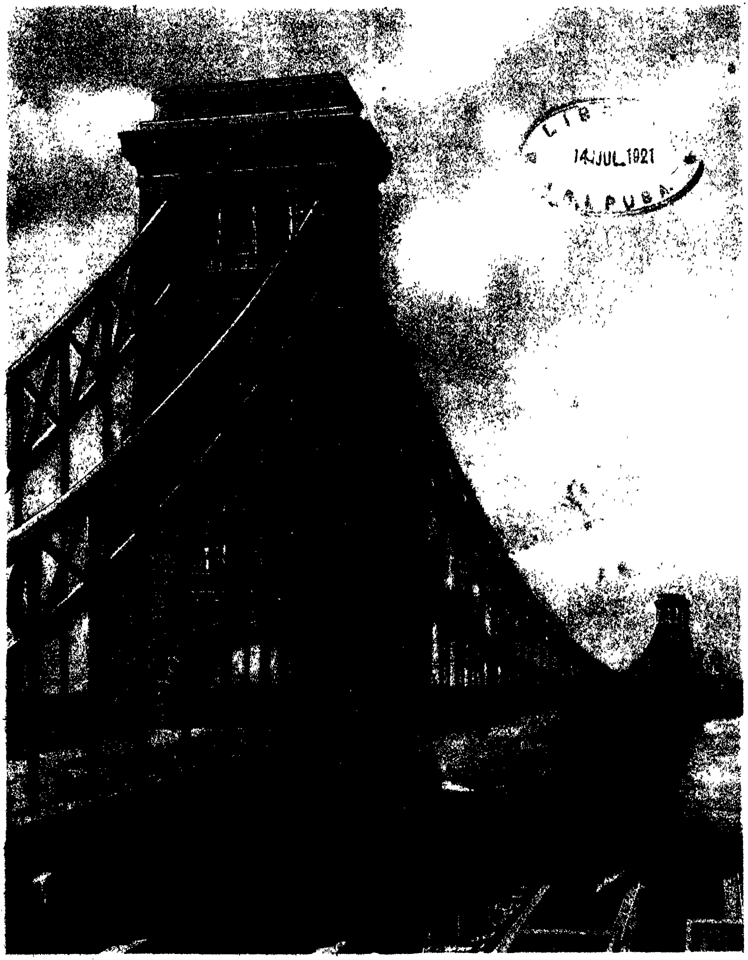

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LINKING NEW YORK CITY WITH THE MAINLAND BY THE HUDSON RIVER BRIDGE.—[See page 450]

Vol. CXXIV. No. 23
June 4, 1921

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A Submarine Plow for the Submarine Telephone Cable

THE danger to which submarine cables are subject in shallow water is well known, and is attested to by the fact that such cables are always designated by the well-known signs, "Cable Crossing. Do Not Anchor Here" For it is a fact that such cables are often damaged by the anchors of even small craft, with resulting inconvenience to the telegraph or telephone company and subscribers alike, not to mention the expense of repairs

The accompanying drawing depicts how a telephone company lays its telephone cables in such a manner that they are reasonably protected against anchors, tides and other sources of trouble A small barge carries the reel of cable as well as a combination mud plow and cable-laying device, and is hauled across the water by an electric hoist, as shown It will be noted that a pair of steel cables are employed to guide the barge in a straight path across the body of water, while a third cable connected with an electric hoist on shore pulls the barge across

The cable is taken from the reel on board the barge and passed down to a grooved wheel behind the mud plow and thence laid in the furrow prepared by the mud plow. The cable is soon covered over with a layer of mud and sand. The depth at which the mud plow operates may be regulated by raising or lowering the upright to which it is attached. A system of signals between the crew aboard the barge and the hoist operator on shore insures proper coordination of efforts.

New Way of Singeing Chickens

ACETYLENE has been aptly termed "the gas of a thousand uses." New uses are being discovered constantly and very many of them are as little related to other uses as may well be imagined One of the most recent and perhaps the most curious uses is for singeing chickens.

It is claimed that the acetylene flame, properly used, performs this operation in a small fraction of the time formerly required by the old process, that it removes the last vestige of feathers from the fowl, and that the burning off is accomplished without scorching the skin or materially heating the delicate superficial flesh That this is possible with the intensely hot acetylene flame would seem hardly possible, were it not indisputably demonstrated.

Strength of Iron Pipe Cast Centrifugally

MODERN Cast Iron Pipe" was the title of a paper read recently before the Engineering Institute of Canada, Montreal Branch, by A F Macallum, commissioner of works, Ottawa His remarks regarding the De Lavaud process of making centrifugally cast iron pipe, already described in this journal, were in part as follows·

The present specifications for cast iron pipe are based on iron having a tensile strength of 19,000 lb per sq in When higher standards are given under the present foundry practice and mixtures, the pipe is apt to be brittle On account, however, of new methods being adopted in manufacturing cast iron pipe, consideration is being given to the revision of the specifications to meet these new conditions This new pipe, developed by De Lavaud, a Brazilian engineer, is now being manufactured and introduced in this country, after exhaustive comparative tests with the ordinary standard cast iron pipe.

The writer has studied with great interest the manufacture of this new type of cast iron pipe, which involves the application of the principle of centrifugal force to molten metal when poured into a permanent mold A regulated quantity of molten iron is introduced into a revolving water cooled cylindrical mold, whereby the centrifugal force exerted causes molten metal to spread uniformly upon inner surface of the mold Within a few seconds the pipe is withdrawn from the mold at a red heat It is brittle after leaving the mold, on account of the outer surface being chilled, but after passing through an annealing furnace it becomes tough and much stronger than ordinary cast iron pipe, as plainly shown by the recent tests made by Professor Gillespie of Toronto University The pipe made under these conditions has a decided contrast in structure to pipe cast in sand molds, and has not the segregation of impurities often found in sand cast pipe As a consequence the pipe is a homogeneous, dense, fine grained iron throughout, having no water or gas bubbles, and because of this density and strength can be made much thinner

In the tests made by Professor Gillespie a 6 in pipe made by this machine was compared with a 6-in ordinary sand molded pipe and out of the same iron with the following results

Centrifugal Cast Pipe Thickness, 0 28 in Tensile strength, 39,000 lb per sq in Modulus of elasticity 14,500,000 Modulus of rupture, 63,800 Quality factor, 20 2

Sand Cast Pipe Thickness, 0 51 in Tensile strength, 16,000 lb per sq in Modulus of elasticity, 8,860,000 Modulus of rupture 33,900 Quantity factor, 9 8

From this it will be seen that the centrifugal pipe has very high tensile, cross-bending and resistance to shock values

It is apparent, therefore, that this type of pipe can be successfully made much thinner than the sand molded pipe For example, a 12-ft length of 6-in pipe weighs 280 lbs., as compared with 430 lbs for a sand cast pipe of the same diameter

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Hudson River Bridge Equivalent to Twenty Tunnels

WE were asked the other day—and the question had been put many times before—why a bridge is preferable to a tunnel as a means of crossing the Hudson River We answered that a crossing, such as will be provided by the Hudson River Bridge, is equal to twenty tunnels in capacity, and can be built for less than half the money

Somebody has stated that nine-tenths of the make-up of a genius is his possession of a keen, quick sense of proportion Life education for most of us consists in a struggle to lift ourselves mentally above the non-essentials of life into the free atmosphere of the few great essentials The men who possess a keen sense of proportion get results and get them quickly They dwell among the high peaks of thought and action, whereas the majority of men get lost among the non-essentials, and fondly thinking that they are upon the mountains, they spend their lives in the shadows of the valley.

It is for lack of a broad vision of the problem that New York City has allowed the Hudson River to cut it off physically, commercially and, we had almost said, politically, from the continent of America Lack of a sense of proportion led the city to attempt to obliterate the Hudson River piecemeal, by driving tunnels beneath its bed, each capable of accommodating only one line of rails

Thirty years ago a few men, such as President Rea of the Pennsylvania Railroad, and his great predecessor, Mr Cassatt, together with Gustav Lindenthal, the bridge engineer, had sufficient sense of proportion to realize that big problems call for big solutions, and so it came about that the scheme for eliminating the barrier of the North River by building one vast suspended highway for freight and passenger travel was placed before a startled and incredulous public

A bridge with a clear span of 3,200 feet, capable of carrying the heaviest freight and passenger trains? Impossible! Hence, for lack of vision and a true sense of proportion, New York has been burrowing under the river in leisurely fashion, with the inevitable result that the rising tide of twentieth century travel has overtaken and swamped us Congestion, increasing in geometrical ratio, stares the public in the face Delays and discomforts multiply in passenger travel and in freight traffic it costs as much to get a ton of merchandise from New Jersey yards to its destination in greater New York as it does to haul it half a thousand miles across the continent by rail

Bridging is better than tunneling because by building a bridge big enough, it is possible to solve the problem at a single stroke, instead of scattering our effort in building a score of individual tunnel units Moreover, the total cost of the twenty tunnels would be just two-and-a-half times as great as the cost of providing equal traffic accommodations by the construction of one great bridge

Now, let us look at this matter more closely To accommodate the great flow of automobile and motor truck traffic for which provision is made on the 200-foot upper deck of the Hudson River Bridge, would call for the construction of ten two-track tubes, similar in size *and costly ventilating plant* to the tunnels which are about to be built under the Hudson at Canal Street Now these ten tubes, judging from the estimated cost of the Canal Street tunnels would call for the expenditure of 150 million dollars Hence, the upper deck of the Hudson River Bridge alone will have a traffic capacity which, if provided for by the tunnel system, would call for a 150-million-dollar investment.

On the lower deck of the bridge there will be provision for ten railroad tracks capable of carrying the heaviest transcontinental passenger and freight trains. To provide equal accommodation by the tunnel system would call for ten separate railroad tunnels whose total cost at present prices would be 100 million dollars

Now, the estimated total cost of the Hudson River Bridge is about 110 million dollars, and hence it follows that, by the erection of this monumental structure, the cities of New York and New Jersey and the whole metropolitan area will have at their disposal a means of communication which, if it were provided by the tunnel system, would cost two-and a-half times as much In other words, one bridge above the river is equal in capacity to twenty tunnels beneath the river; and it can be completed in less time and at less than one-half the cost

Hydrographic Office Should Remain with the Navy

THE McCormick Bill, introduced by Senator Knox, which provided for the transfer of the Hydrographic Office from the Navy to the Department of Commerce, died with the last Congress—fortunately so, for the proposed transfer would have been very ill-advised and vicious The question of transfer, however, will undoubtedly be raised in the Congressional Joint Commission to reorganize the Governmental departments, which Commission, by the way, has just elected Mr Walter R Brown, the President's representative, as its chairman

The absolute need of an office under the Navy Department whose duty it is to provide all our naval vessels with up-to-date charts, sailing directions and other information relating to the sea and navigation, was realized early in the career of our country Under the naval officers in charge, we were pioneers in the study and investigation of ocean currents, marine meteorology and terrestrial magnetism, with its effects on the mariner's compass Under their direction our naval vessels made many hydrographic surveys in different parts of the world Our Hydrographic Office initiated the Pilot Charts, which are issued monthly of some oceans, quarterly of some others and which are of inestimable value to all seamen Other great maritime nations have followed our lead.

The primary purpose of the office, which must not be lost sight of, is to keep our Navy and its ships in all parts of the world supplied with charts, sailing directions and a vast amount of the latest marine information with all changes to date *The Hydrographic Office is a vital part of the Navy itself and its work cannot be done by civilians in another department* Without proper data and marine information of the kind furnished by this office, our naval vessels could not operate safely either in peace or war The maintenance of the Hydrographic Office under the Navy Department is just as essential to the efficiency of the Navy as is its Bureau of Ordnance

In addition to its primary purpose, the Hydrographic Office incidentally furnishes to the merchant marine much of the same information (but, of course the office has much confidential data and many confidential charts which are furnished only to naval vessels) The scope and value of the information given to the merchant marine has been greatly developed and increased by the ability and wisdom of our naval officers, and its value to merchant sailors cannot be overestimated Merchant sailors fully appreciate it

No other department of the Government is, or can be, as well equipped as the Navy to investigate, collect from all parts of the world, compile and distribute this information No civilian in the Department of Commerce or elsewhere can have the same realization of what is needed by sailors as have our naval officers—educated, practical seamen and navigators—nor can a civilian have the same vital interest in the work No civilian department can make sure of supplying every ship of the Navy, wherever she may be, with every chart she may need, with corrections to date

If this one activity were to be transferred from the Navy to the Department of Commerce (and presumably to the Coast Survey), what would it mean? It would mean, unless the efficiency is to deteriorate greatly and immediately, that the Coast Survey must be immediately supplied with a considerable fleet and large personnel to survey in many different parts of the world in order to do work that is now being done daily, quietly, efficiently and economically by naval vessels stationed in those waters, at intervals between the performance of other naval duties. Naval officers have made surveys in Korea, China, Mexico, Central America, Brazil, Uruguay, South Atlantic, South Pacific, Indian Oceans, and in many other places—waters of countries which do not have fully equipped hydrographic offices of their own. These surveys involved very little additional expense. If, however, similar surveys are to be carried on by the Department of Commerce, the expense of sending ships to any one of these places will be great, for they will have no other reason for going. In fact, the cost will be so great that comparatively few of the needed surveys will be made.

The Importance of Instincts

IT is commonly supposed, in popular conception, that in the lower animals reason plays at most a subordinate rôle while instinct reigns supreme; and that in man the condition is reversed, instinct regulating for the most part only the more elemental functions, while the more complicated phases of conduct are determined chiefly by reason.

That instinct performs, especially among certain insects, functions which to us appear almost miraculous, will not be denied by any student of nature. In this respect there seems little occasion to revise the popular conception But there is much reason to suspect that the rôle of instinct in human affairs is commonly much underestimated. The fact is that reason alone furnishes no *motives* of any kind for action. If we could imagine a purely reasonable being, devoid of emotions and feelings, this creature of our imagination, to be consistent, must be thought of as wholly inert. There would be no pleasure or pain to make it seek one course and shun another It might be endowed with full and perfect knowledge of the consequences of any action that it might elect to perform; but having no feelings it would be wholly indifferent to such consequences, and would make no selection in favor of one line of action in preference to another.

It may be urged that reflections on such an imaginary being are hardly even of academic interest. They derive, nevertheless, a certain utility from the circumstance that we can often more clearly perceive a fact or a relation if we consider an extreme example, even though this example be a mere imaginary abstraction, a sort of caricature of the things having real existence It is true that a wholly emotionless, feelingless person, in full possession of rational faculties, is at most a figment of the imagination But though such an extreme case can never have real existence, men do differ widely in the intensity of their emotional makeup, and there is much reason to believe that these differences in temperament, rather than differences in intellectual endowment, determine the place that each man is fitted to occupy in the social scheme For, as Young has said, "With the talents of an angel a man may be a fool" It is not enough to *be able*, there must be a strong impulse to *do*

Among the most powerful impulses that drive men to accomplish—powerful, often, especially among those of large endowment—is the instinct of workmanship and self-expression With such persons creative activity is not primarily a calculated means toward a material end, it is the direct following of an imperative impulse that brooks no disobedience. For, to quote Owen Meredith, while talent does what it can, "Genius does what it *must*" Lowell, in advising a prospective author as regards the acquisition of literary style, tells him that the first requirement is to have something that "Will not stay unsaid" Similarly Arnold Bennett says of the author that "He cannot keep himself to himself, he is bound to tell" And elsewhere he says: "The artist works under the stress of instinct." We need not hesitate to say that the same is true of the great creative worker in any field, whether it be science, commerce or what not. Speaking quite generally, the greater a man's achievements, the stronger is the presumption that he was impelled, unconsciously perhaps, rather by the blind instinct to use his talents to the full, than by any thought of material reward.

Thus instinct plays, indeed, a most significant rôle, not only in the regulation of our prime, our most elemental functions, but also in directing human endeavor in the very highest flights of which it is capable.

Naval and Merchant Marine

Triple Turrets Becoming Universal.—The system of mounting three guns in a single turret, first used in the Italian battleship "Dante Allighieri," and later by the Russians, Austrians and ourselves, bids fair to become universal. The recent target practice against the "Baden" was made by British 15-inch guns mounted in an experimental triple turret.

Suez Canal to Be Tunneled.—The great military base at Kantara, from which the British built a military railway through the desert to Palestine, is being dismantled. The line, of course, is permanent. During the war the Suez Canal was crossed by a large swing bridge, which is now to be dismantled. Connection between the Egyptian railways and the new line to Palestine will be maintained by means of a tunnel which will be built below the Suez Canal.

Ship's Gear the Complement of Wharf Cranes.—The New York-New Jersey Port and Harbor Development Commission, in its recent report, states its belief that a ship's gear plays a useful part in coöperation with wharf cranes in promoting rapid loading and unloading of cargo carriers. Ship's gear is standardized equipment. It is found on every ship, and its use is universally understood. Wharf cranes should be designed with the idea of coöperation with the ship's own hoisting gear to secure the quickest loading and unloading results.

Yacht Speed Fifty Years Ago.—In the course of some historical articles on the performance of early yachts, the *Yachting World and Marine Motor Journal* gives some interesting details regarding the famous schooner "Alarm," of 248 tons, built in 1830 at Lymington, England, as a 193-ton cutter, lengthened and enlarged to 248 tons and converted to schooner rig in 1852. In a race of 52 miles against the Swedish schooner "Sverige," of 280 tons, the "Alarm" won by two minutes, at an average speed of 12 knots. That would be good going in these days for a schooner of that size.

Fleet Flying Boats.—We have heard much lately of fleet submarines. The latest development is the fleet flying boat—that is, craft which, unaided, can cruise with the fleet. The new boats built for the British navy are known as the Felixstowe Fury type. They weigh 15 tons, have a wing span of 140 feet, Rolls-Royce engines, with a total horsepower of 2400, giving a range of about 1500 miles. They have a crew of seven. These boats will go out with the fleet and will remain with it. When not scouting, they will taxi on the surface, and the hulls have been constructed of sufficient strength to enable them to face heavy weather.

"Fuel for Nothing."—The case of a motor ship that trades between Europe and America without having to pay for fuel is mentioned by *Motor Ship*. The "Buenos Aires," running between San Francisco and Scandinavia, loads up with 1,500 tons of fuel oil at San Francisco, sells 800 tons at Stockholm, and returns to America with some oil left in her tanks, having used 600 tons out of the 1,500 tons of her supply in her engines. She pays 7,500 pounds for her oil in San Francisco and sells 800 tons of it at Stockholm for 8,000 pounds. The fuel is carried mostly in the double bottom, and therefore does not detract from the ship's cargo-carrying capacity.

The State Canal Under State Control.—The passing of the New York State Barge Canal into complete State control is naturally hailed as a good augury for the future prosperity of the waterway. As part of this movement, the Government is disposing of the fleet of canal boats, some of them self-propelled, which was built during the war, especially for this service. The fleet is thoroughly modern and represents some careful thought and planning. It is hoped that the bids will approximate the present value of these craft and that a reputable organization desirous of furthering canal interests will secure this fleet. Otherwise, it will be sold to individual speculators for what it will bring, and the boats will be scattered.

"Bismarck" to Be Named "Majestic."—The German liner "Bismarck," sister ship to the "Vaterland," now the "Leviathan," is nearing completion at the yards of the Blohm and Voss Shipping Company at Hamburg. This ship, with a length of 950 feet and a beam of 100 feet, will have a gross tonnage of about 56,000. The builders claim that she will be a better boat than the "Vaterland," the experience gained in that ship being embodied in her. The "Bismarck" was handed over to the Allies under the terms of the Treaty, and has been sold to the White Star Line, who will rename her "Majestic," when she hoists the company's flag and takes her place in the service from New York to Europe.

Science

Lightning Freak.—Lightning is apt to do anything which is irregular. It struck a Dickenson College dormitory and hurled a freshman seven feet across a room while others a few feet away were not touched.

Highest Mountain in England for Sale.—Who wants to buy Mount Snowdon, which is the highest mountain in the British Isles? It is now listed for sale by its owner, Sir Richard Williams Bulkeley. Sir Richard is probably the largest land owner in Wales.

The High Cost of Education.—It will cost Columbia University $7,271,393 to carry on the way for the fiscal year beginning July 1st. Twenty-four states of the union have annual budgets of less than this. Columbia will expend $4,173,168.29 for administration and $536,108 for the care of the buildings and grounds. Miscellaneous items make up the balance.

American Unearths Ruins of a Greek City.—Ruins of a prehistoric city have been discovered by Professor Carl Blegen of the American Archaeological School at Athens. The city he has found was situated between Corinth and Mycenae, in southern Greece, and pottery and fragments of statuary unearthed fix the date of its prosperity at about 2000 B.C.

A Sight-Saving School.—A sight-saving public-school has been formed in a school in Canada. It is located in a large and specially lighted room and there are a dozen pupils to start with. Ordinary text-books are done away with and special books with very large type (24-point type) are used. Pen and ink as well as white paper is discarded. Instead soft pencils and a cream shade of paper with green lines are used. When it is borne in mind that 24-point type is ⅓-inch high, this scheme does not seem to be very practical in the case of the already bulky text-books.

Saved with Dynamite.—A thrilling story comes out of northern Ontario. The women of an Indian encampment were attacked by timber wolves while the men were absent trapping. With the few rifles left in the camp the women defended themselves until the ammunition gave out and their situation became perilous. An Indian boy thought of some sticks of dynamite for use in lakes when fishing was bad. A bundle of them with caps and fuses was thrown among the wolves and the explosion killed 36 wolves and frightened off the remainder.

Reading in Bed.—An English scientist after an exhaustive study of the eye and eye strain says that reading in bed is not harmful provided one sits up and looks down at the print, the light of course being good. Looking at pictures in an exhibition is always very tiring to the eyes. The cause goes back to the time when man and the higher apes first developed the use of the opposing thumb. The object picked up and held with the aid of the thumb was held below the eyes. Thus the muscles that turn the eyes down became more used than those which turn the eyes up and less sensitive to strain.

Rifleman to Guard Fish.—One of the most novel jobs in the United States is held down by a man in Oregon. The State Legislature has just commissioned him official sea lion hunter and he is to work in coöperation with the State Fish Commission to rid the coast of Oregon of the sea lion menace which destroys more fish than all the famed canneries of the district combined can pack. For bounties the hunter has brought in over 10,000 sea lions. Thousands of tons of salmon are destroyed annually by the peculiar land and water beast against whom the hunter wages merciless warfare. The secretary of the State Fish Commission states that during the 157 days which constitute the open season, and during which the canneries are allowed to operate, sea lions along the coast consume 41,500,000 pounds of salmon.

Imported Brick a Colonial Fable.—One of the institutions of the middle Atlantic States is the house that was "built of brick brought from England as ballast." All other houses crumble and decay, or at least get greatly out of repair, but these seem to have a charmed existence. The importation of brick into the North American colonies, especially into Maryland and Virginia, must have been the leading industry of that period, and the records must be out of joint because they do not contain references to this important trade. The Custom House records are silent on this point. Excellent deposits of clay were found in Virginia and Maryland. Bricklayers or "brick masons" as they were called, were among the early settlers and they probably did not wait until the ships came in, "in ballast." It is a curious example of the survival of a story which is far from true and we can vainly scan the houses at Annapolis or Yorktown for true examples of English brick.

Electricity

Electricity vs. Horses.—If a horse could deliver horsepower, then it would take 10,000,000 of the 23,000,000 horses in the United States to furnish power now supplied by central electric stations of the country, according to *Electrical Review*. In 1902 less than 1,500,000 horses would have sufficed.

Electrification of Philippine Railroads.—In regard to the plans of the Manila Railroad Company for the use of electric motive power on its road, the Bulletin of the Philippine Government Commercial Agency in New York states that the electrical power will be developed from the Agno River, in central Luzon, which is believed to possess a potential capacity of from 12,000 to 15,000 horsepower. A thorough topographical survey of the entire water power site is being undertaken and early reports of the survey would seem strongly to point to the feasibility of the project.

Electric Locomotives for Brazil.—The electric locomotives for the Paulista railroad in Brazil, which was recently described in our columns, are now being built in the United States. In fact, the first of these has been completed. It is a freight locomotive weighing 105 metric tons and has six driving axles, each equipped with one 280-horsepower direct current motor, arranged for operation with two motors in series on the 3000-volt line. This locomotive has been designed to handle trailing loads up to 700 metric tons over a line having a maximum grade of approximately 2 per cent.

Water Power in Halifax.—A plant is under construction at St. Margaret's Bay about 15 miles from Halifax, which is expected to furnish sufficient light and power for the city, according to a report from our Consul. This is under the direction of the Nova Scotia Commission and will mark the partial completion of its first important development. The question is yet to be decided whether the Halifax municipality or the street car company will receive and distribute the power. Other private interests are constructing plants which will utilize the tremendous river force of Nova Scotia.

An Anti-Glare Lamp.—From England comes the good news that Mr. Alfred E. Terry has invented a useful apparatus which abolishes the usual diffused glare from motor car lamps, and enables drivers in the opposite direction to see whether the road is clear. It consists of a grid composed of thin aluminum plates crossing at right angles and forming a network of square tunnels about ⅜ inch wide and 2 inches long. These are held in a frame which fits on to the lamp. The result is that the beam is concentrated about 4 feet or 5 feet in front of the lamp, whence it widens out to give sufficient light laterally, while at the same time an increased range directly ahead of some 20 yards compared with bare lamps is obtained. A demonstration shows that glare is largely avoided.

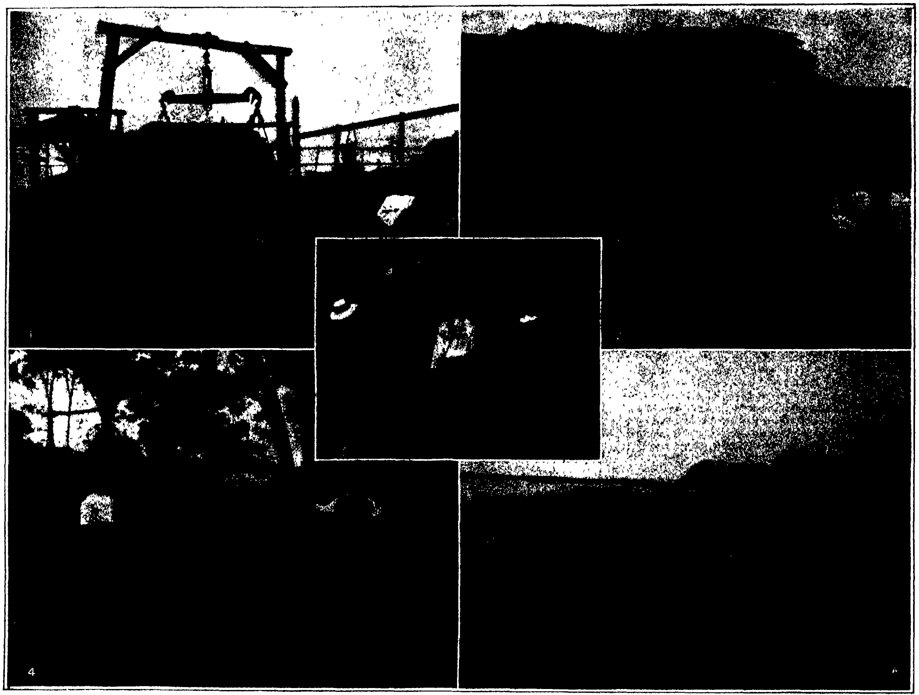
Automatic Heat Regulation of Electric Cars.—Among the new devices that are being introduced in electric railroading are the automatic heat regulators or thermostats. These devices, it is said, save over 50 per cent in the consumption of current by the heaters, and save over 10 per cent on the peak load. Furthermore, they are said to reduce the cost of maintenance on heaters for the reason that they prevent overheating with its destructive effects. The mechanism of the thermostats is quite simple. The mercury tube is mounted on springs and is not affected by vibration or jar of the car. The metal conductor around the mercury bulb makes contact on the outer case and transmits the temperature of the air on the outside of the case so readily to the mercury that the manufacturers guarantee it to regulate within one degree. Something like 19,000 of these thermostats are now in use.

Telephonic Measurements.—In a paper by Sir William Noble on "The Long Distance Telephone System of the United Kingdom," recently read before the Institution of Electrical Engineers, some interesting facts are brought forth regarding delicate telephone measurements. It is pointed out that the developments of recent years have extended the practical limits of telephonic science. Thus measurements and adjustments of the capacity and resistance of cable conductors are now made to an extreme degree of accuracy at frequencies of 800 cycles per second and higher. The amplifiers used are exhausted to a pressure of 0.00001 mm. of mercury, probably the highest vacuum employed in commercial apparatus. These methods and devices, the employment of which a few years ago was possible only in the best-equipped laboratories, now form part of the standard construction and operation of long-distance telephone plant, and are the everyday concern of the telephone engineer.

Our Tropical Timber Trade

Some of the Valued Woods for Which We Must Rely Upon the Countries to the South of Us

By Samuel J. Record, Professor of Forest Products, Yale University



1. Preparing a batch of logwood for weighing (Hayti) 2. Pile of straight Haytian logwood ready for export to the United States. 3. Hauling out a squared cedar log from the Central American forest, on ox cart with solid wooden wheels 4 Pile of Brazilian rosewood for veneer, sawn in half by pit saws and all heart defects removed. 5. Rafts of squared mahogany and Spanish cedar on the beach awaiting high tide

Tropical forest products on their way toward shipment to United States ports

THE timbers we derive from the tropics are the gold-nugget woods of the forest Our demand has always been for the unusual and fancy, for woods prized for their beauty, their fragrance, their medicinal virtues, or some other special and peculiar property There is reason to believe that this condition is going to change with the vanishing of our virgin forests, but the only contribution the vast tropical forests have so far made to our timber market is limited to special woods for special uses

Our greatest demand on the tropical forest is for furniture wood First in importance comes mahogany, the premier of the cabinet woods It is of long established and enviable reputation, but not all that appears on the market under that name is genuine There are but four species of true mahogany known and they grow naturally only in the West Indies, the Florida Keys, Mexico, Central America, and northern parts of South America

The center of mahogany production is now in Mexico and Central America. The business is controlled by a few companies who handle all of the operations from the woods to the manufacturer. Here is one of the few instances where the crude and desultory native methods of logging have given place to organized effort The trees are cut, the logs squared, hauled out on the beach at low tide, roped together into rafts to be towed to navigable water and later hoisted aboard a steamer bound for an American port The sawing is done in this country because logs are more rapidly handled than lumber and milling conditions here are more satisfactory. Much of the finely figured mahogany is cut into veneers

Most of the African mahogany, closely allied to the genuine, comes from the Gold Coast and neighboring regions The trees which supply it are usually of very large size and in squaring the logs the natives fairly swarm over and about the prostrate trunk. It is a hard struggle to get the timbers to the railroad and arrived in the yard it is a common practice to thatch them with palm leaves to ward off the intense sun There is also considerable lumber from the Philippines sold under the trade name of "mahogany" In fact a tropical country is poor indeed that cannot produce from one to a dozen "mahoganies" It is reported that the wood of the sandbox tree, the possum-wood of Dutch Guiana, is soon to make its debut on our market as yet another "mahogany," this time a white one. The term "white mahogany" is now often applied to the prima vera

One of our favorite furniture woods is the Circassian walnut, though this can hardly be classed as a tropical wood. It has the good cabinet qualities of our native black walnut but the wood is more conspicuously figured There are various tropical woods called "walnut" for commercial purposes, though they are not common in our market. The so-called Brazilian "walnut" is what is known locally as the frei-jorge. It produces valuable lumber and is being shipped in quantity to Europe for use in place of oak for cooperage.

The Spanish cedar or cedro, cousin of mahogany, is extensively used in this country, almost exclusively for cigar boxes. It is a cedar only by courtesy and owes its trade name to its cedar-like fragrance Most of our supply comes from the mahogany forests and the two woods are handled together Thirty-six different species of cedro have been found in various parts of the American tropics. It is one of the most valuable woods locally for construction purposes and it is not unlikely that it will before very long be used for house siding in this country.

We normally consume about 3,000 tons of boxwood. The Turkish and Persian boxwood, the finest textured and most homogeneous wood known, formerly ruled the market, but is now very rare. It is an ideal wood for engraving, for instruments of precision, and for

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The Burning Mines of the Hocking Valley

By Harry A. Mount

ONE spring day in 1884—thirty-seven years ago—guards in seven mines in one of the finest bituminous coal fields in this country simultaneously discovered fire in their mines. The miners were on strike and it had been rumored the day before that strike-breakers were on the way Oil cans scattered about the mine entrance gave evidence that the fires were the work of vandals.

Today the fire is still burning. It has rendered almost useless the entire coal deposit, extending over some seventeen square miles of territory between the little mining towns of Shawnee and New Straitsville, Ohio, it has actually destroyed more than 15,000,000 tons of coal under about 1,500 acres of this territory; it has turned a once prosperous community into a graveyard of hopes. Those few miners who still eke out an existence by working the outcroppings of coal in the fire district do so at the daily risk of their lives

The fire has resisted elaborate efforts made by the state to save this enormous store of fuel and numerous efforts of private firms to save their property The fire is burning more fiercely today than ever before and experts of the Ohio Bureau of Mines say it is just getting a good start' It is predicted that it will burn for nearly a century to come with little hope that it can ever be extinguished

The fire is in a particularly fine vein of coal in the Hocking Valley district Nearly the whole vein is practically free from slag and is from five to twenty feet in thickness That part which already has burned averaged about ten feet in thickness

The fire is particularly difficult to control because of the fact that most of the coal is near the surface, running from ten to fifty feet deep, much of it being suitable for stripping operations As the coal burns out the ground sinks, causing fissures in the earth through which the fire receives a new supply of oxygen

Not only has the fire destroyed an enormous store of good coal, but it has wrecked a whole countryside Lands have been burned brick red by the great heat from beneath, destroying all vegetation and rendering the ground unfit for cultivation Scores of homes have been abandoned and have tumbled into the sink holes that engulf the country in the wake of the fire

One whole village, the town of Old Straitsville, has been abandoned Wells in this vicinity are sometimes boiling hot and there are steaming streams running through woods in which the trees have been burned off at the roots and have toppled over in confusion Occasionally the pent-up energy of the burning coal bursts forth in a miniature volcano, and at night scores of these craters can be seen from a hilltop in the heart of the fire district Paved roads have been undermined and have sunk in. In brief, the fire district presents a picture of the utmost desolation. The few persons who have remained with their lands are retreating stubbornly before the advance of the fire but without hope Only those mines in which it is possible to secure good ventilation can be worked and even then they have to be abandoned long before the fire actually reaches them because of the presence of the deadly fire damp.

One miner owned a considerable section of rich land and was moderately wealthy. The single opening he can work will soon have to be abandoned and it furnishes now a meager living by hauling coal from it in wagon load lots One day last summer his small herd of cows went into the entrance of an old mine, attracted by the cool shade, and next day he found them there all dead from fire damp Their bones are now cremated

The writer came upon a gang of five men in the heart of the fire district engaged in making a new entrance to an outcropping vein. The entrance they had used the day before was now a roaring furnace During the night the fire had broken through from an adjoining shaft There was an explosion that shook the surrounding country and which blew a twenty five foot crater in the hillside This formed a sort of natural flue for the burning mine and flames roared fifty feet into the air The men intended to blast down the burning section of the mine to retard the fire while they opened another entrance. This would allow them to work a few more days before the fire caught up with them

About a hundred feet from where they worked was a stream of steaming water, which, they said, was hot

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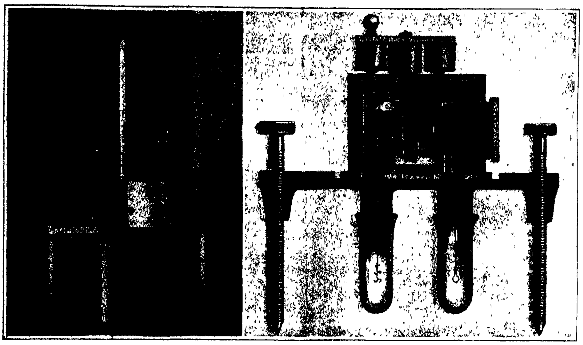
Left: A fissure in the ground through which red hot earth can be seen. At night such spots as this dot the countryside with cherry-red patches. *Right:* The day before this picture was taken work was going on as usual in this shaft, now it is a roaring furnace

Scenes on the ground under which Ohio's great subterranean fire rages

Weighing the Ten-Millionth of a Milligram

By Dr. A. Gradenwitz



The quartz-fiber micro-balance that is sensitive to a millionth of a milligram, and a drawing showing its construction

WHEN a young Swedish physicist, Dr Hans Petterson, in the fall of 1911, commenced his work at the University College, London, the subject suggested to him by Sir William Ramsay was a closer investigation into a curious phenomenon observed by himself, viz, the temporary loss in weight of a tiny gold capsule raised to a red heat The quartz micro-balance designed by Steele and Grant was to be used in this connection and the newcomer to Sir William's laboratory was to try even to improve it, so as to make it stronger and less difficult to work with This difficult problem was solved most satisfactorily, the work being later continued at Stockholm

The knife-edge support of the balance was replaced by a suspension consisting of a pair of quartz fibers, a magnetic arrestment being employed The thinnest portion of these fibers, viz, the portion bent during oscillations of the balance, is only a few thousandths of a millimeter thick, thus being invisible to the eye and requiring, to be made visible, a strong side illumination under which it appears as a rainbow-colored gleam, the tint indicating the thickness of the fiber The bearing capacity of these extremely thin fibers was found to be unexpectedly high, amounting to several grams, which corresponds to the strength of hardened steel The drawing out of the fibers is effected in a few moments in the oxygen flame at a temperature corresponding to a white heat This does away with the whole laborious work required in sharpening and adjusting the knife edges used in connection with ordinary balances The fibers are also of a remarkable flexibility, thus enabling the sensitiveness to be driven to figures so far unheard of Moreover, on reducing the thickness of the fibers the flexibility will increase more quickly than the bearing capacity decreases so that the new micro-balance, in opposition to all those so far constructed, will work the better as it is made smaller

The construction of the first micro-balance designed on these lines demanded several months' laborious work, though, on account of the unprecedented sensitiveness obtained, it proved to be worth all the pains taken When Dr Petterson's work was continued at the University of Stockholm the street traffic, during those nights when the most delicate tests were made, was deviated from the university building.

The beam of the balance is entirely of quartz In the one recently constructed it is only 5 centimeters long and weighs a fraction of a gram Weighings are taken in a hermetically closed case inside of which the air pressure can be reduced as far as a very high vacuum, thus varying the upward pull of the air on a minute air filled sealed quartz bulb suspended on one side of the balance The variation thus produced in the effective weight of the bulb can be calculated with an accuracy of fractions of

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Revolutionizing an Industry

How Modern Machinery Is Minimizing Hand Labor in Hemp Production

By George H. Dacy

TIME was when the sweat of the brow, the bend in the back and the utter fatigue of the laborers were the barometers which accurately recorded our domestic progress in hemp production The limiting factor which restricted the culture of hemp and which prevented the rapid expansion of the industry was the human labor item Much of the arduous, age-aiding work had to be performed by hand Only the most robust and rugged laborers were able to stand up under the severe strain of year-round activities of this description

Inventors devoted their most able energies toward the perfection of mechanical devices which would take the backache out of hemp breaking Despite the combined efforts of science and industry, the practical solution of the problem eluded all these technically and practically trained sleuths until the last decade The various early models and designs of hemp harvesting and breaking machinery, however, acted as stepping stones which gradually led to the perfection and commercialization of field implements and mill appliances which now have stabilized the business of hemp farming and which have reduced the problems connected with the culture of this crop to as simple a basis and system as those that are involved in the production of corn or the small grains

All hemp was formerly broken by hand—a back-breaking, arduous job

Hemp is produced principally in this country for fiber although the foreign supplies of hemp are also utilized for seed and for medicinal purposes In the United States, the greater part of our annual domestic supply is used in manufacturing commercial twines and wrapping cords and to a limited extent also for the manufacture of ropes and binder twine Hemp tow is used as oakum for caulking ships and for packing in pumps, engines and other machinery Our present production of hemp is insufficient to satisfy the demand for commercial twines so that little attempt as yet has been made to develop the other possibilities of this remarkable fiber crop It is also valuable for the manufacture of bagging for cotton bales, for sacking of all kinds, carpets, rugs, seines, nets, fishlines, sewing threads of all description, warp for carpets, and for such fabrics as crash toweling, rough sheeting and rough clothing

On account of its great tensile strength, its water-resistant properties and its ability to withstand wear, hemp is well suited for cordage of all kinds, for lines and ropes used in all shipping operations, for canvas, for all purposes where strength and durability rather than beauty and fineness of texture are desired. Hemp is much like flax in chemical and physical properties and this resemblance has been capitalized by the use of efficient power-driven machinery. By a process known as hackling the hemp fiber is reduced to a condition like the coarser grades of dew-retted flax and can be subsequently spun on flax-spinning machinery

Harvesting hemp with a modern machine which cuts and spreads the stalks

In the neighborhood of 42,000 to 45,000 acres of hemp are annually grown in this country, the yields of fiber ranging from 1,000 to 1,500 pounds to the acre. Hand labor is no longer necessary in producing and harvesting the fiber, field implements now being available which simplify the production of the crop. Specially equipped mills have been constructed and established in sections where hemp is grown on some scale for separating the fiber from the stalks. Wisconsin, which grows about 8,000 acres of hemp a year and ranks as the second state in the country in total acreage and production of fiber, has developed her industry during the last ten years and now operates 11 of the 18 hemp mills to be found in the United States.

Hemp is an annual plant which attains a height of from 5 to 15 feet and is of value due to the fiber contained in its woody stems. The crop is seeded thickly so that the stalks will grow high and slender The fiber obtained from the hemp is called bast fiber and is of value on account of its length, strength, pliability and general resistance to wear and tear. The system of milling the hemp known as breaking consists in separating the woody portion of the stems from the fiber.

Wisconsin's establishment in the hemp growing business is a story with a rather romantic angle. Uncle Sam appreciated that this hemp industry was tobogganing rapidly toward extinction unless he could eliminate the hand labor difficulties. Twelve years ago the National Department of Agriculture in coöperation with the Wisconsin Agricultural College began growing hemp in Wisconsin, the soils and climate there being admirably adapted for the production of this fiber crop As soon as it was demonstrated irrefutably that hemp would prove a success in Wisconsin, the authorities exerted every effort toward the perfection of some mechanical device for breaking the crop and reducing hand labor to a minimum Experienced hemp growers and a large harvesting machinery company coöperated in this work and ultimately appliances were developed which efficiently performed all this work rapidly and at relatively low expense.

In establishing the industry on a practical basis,

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Left: The raw fiber from the Wisconsin mills is sold to large European and American spinning companies which manufacture the finished products. *Right:* Sewing thread, seeking twines, wrapping cords, binder twine, and oakum—these are some of the products made from hemp fiber

Scene in a spinning mill handling hemp fiber and some of the finished products

General view of the Oehmichen helicopter, with the gas bag removed, and a near view of the 20-25 horsepower engine which drives the two lifting members by means of belts

Is the Practical Helicopter in Sight?

By George Gaulois

THE helicopter, long held as a classic joke in aeronautical circles, may be coming into its own at last. This does not mean to say that the practical helicopter is already realized, but it does mean to convey the very definite impression that at last the helicopter inventors are getting down to real engineering principles and are developing designs which hold some promise of future success. The day of the toy helicopter with rubber-band motors, intended to represent the merits of a given type of proposed helicopter, is gone. Inventors are now building full-sized machines, equipped with real aviation engines and man-carrying bodies, in order to prove the worthiness of their designs And in so doing they are rapidly convincing us that there is some hope after all for helicopter flight.

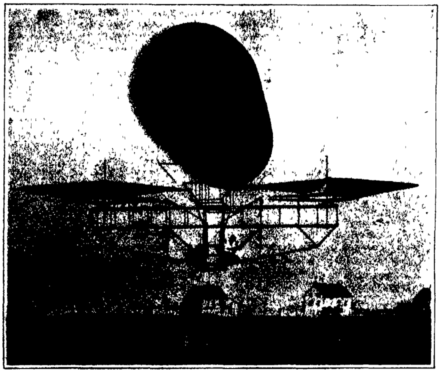
The shortcomings of the airplane have paved the way for the helicopter. First of all, the airplane has to maintain a high rate of speed in order to sustain itself in the air. By the same token it must take off at a high rate of speed, and land at a considerable rate of speed, both of which contain many elements of danger Then again, the way in which the airplane takes off and lands calls for a large landing space, which makes the airplane impractical for use in cities and over rough country where large fields or clearings are not available. Still further, the airplane, by the very fact that it must keep moving while in the air, is not suitable for military, photographic, observation and other purposes, where the facility to hover is a prime requisite

All these shortcomings have brought about a demand for an aircraft that can rise vertically, maintain itself at any desired altitude, move in any direction or hover over a given spot and descend in a direct vertical line when the flight is terminated. The helicopter, theoretically at least, seems to contain all the latent elements of such flight.

During the past year or two there have been several serious attempts to evolve successful helicopters. In the United States we have had the experiments of Crocker and Hewitt, which were quite convincing even if they were not pushed beyond the experimental stage. Then there has been the neat little machine evolved by Berliner, son of the well-known telephone and phonograph inventor. In Spain there is the helicopter of Pescara, which is shortly to receive a series of rigid tests by the French army authorities. All these machines, which make use of co-axially mounted screws revolving in opposite direction, have been described in these columns.

We learn from Harry Harper, Technical Secretary of the British Civil Aerial Transport Committee, that remarkable results have been obtained with the helicopter invented by Lieut Stefan von Petroczy, of the Austrian Army Balloon Corps In fact, this machine is acknowledged to be the first helicopter in the world which, after making an ascent, has remained for any time hovering in the air at the distance it has risen from the ground. However, the Petroczy machine has not made a free flight, for in every flight it has been controlled by a series of cables paid out by winches on the ground. It has gone straight up under its own power

(*Continued on page 458*)



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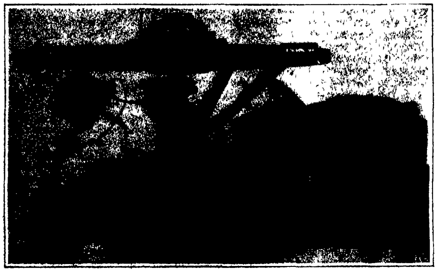
Oehmichen helicopter in flight, said to be the first helicopter to make a free flight, although it is equipped with gas bag



Apparatus employed by the Bureau of Standards for measuring vapor pressures to a fineness of one part in from three to five thousand

Measuring Vapor Pressures

WHERE accuracy in measuring vapor pressures to a fineness of one part in from three to five thousand divisional units is the desired objective, two types of instruments recently perfected by the United States Bureau of Standards meet the requirements The two mechanisms, although widely differing in appearance, have much in common, and in functioning in the Government laboratory their uses are well nigh interchangeable Each, however, varies in construction and possesses respective merits

The photograph showing the scaffold like arrangement is a pictorial embodiment of the new manometer designed by the Bureau of Standards aiming for accurate measurements up to fifteen atmospheres It is to be employed extensively as a primary standard with which to calibrate other gages as well as for its limited application as a working unit The apparatus consists of five V-shaped tubes, 2 5 meters long, mounted on a steel framework and so equipped with valves that any combination of these tubes may be used The lower half of each of the tubes is filled with mercury while the upper half contains a light liquid (at present alcohol) for the transmission of pressure The two sawed off V shaped tubes shown in the upper left hand corner serve to divorce the alcohol from any gas, the pressure of which is to be determined

The photograph which presents the revolving mechanism, which might be mistaken for a diminutive "spinning jinny,' in reality illustrates a piston gage, built for determining accurate measurements of pressures up to 100 atmospheres It is easier to operate than the manometer just described, and the scientist lends himself to the negotiation of this apparatus as preferable to the former in making actual pressure measurements It consists of a steel piston snugly fitted within a steel cylinder The pressure, transmitted by oil from a short mercury manometer mounted on the base of the gage, acts against the base of the piston and exerts an upward force upon it. This exertion is balanced by piling the weights, shown in the right of the illustration, upon a steel column which extends up from the piston During the pressure measurement the piston is continually rotated to prevent it from sticking. A small dial gage indicates the approximate pressure, and aids the operator in balancing the piston gage Like the manometer, extreme accuracy is a positive virtue of the piston gage--being exact to the fineness of one part in from three to five thousand integral parts

Ostrich Skin Shoes

WE have recently had many odd leathers such as shark skin, porpoise, etc., and now the ostrich comes forward to help leather shortage Shoes made of leather from ostrich skins will outlast leather. The ostrich always had a reputation of being a tough old bird

Reorganizing Our Government Machinery—II

Some Concrete Reasons Why Rearrangement for Mere Rearrangement's Sake May Not Be a Good Thing

By C. H. Claudy

LAST week we gave Mr Claudy space in which to set forth the conviction, which he shares with most of those responsible for the conduct of the Bureaus and Departments, that in the necessary reorganization of Governmental agencies which will sooner or later be made, there is great opportunity for Congress to do the wrong thing if not wisely guided. In this issue Mr. Claudy brings out a number of specific instances to show that the scheme of grouping together indiscriminately all agencies doing similar work is not necessarily sound in every case. In many cases it is sound, and much of the consolidation of this character that is discussed should be effected. But every case should be decided upon its merits, as Mr. Claudy so clearly brings out; and the Navy, for example, should not be robbed of one of its essential branches just because somewhere else in Washington similar work is being done with another end in view.—THE EDITOR.

WHEN the machinery in a factory becomes worn out, it is replaced If out of order, it is repaired If out of date it is scrapped and a new and better engine put in its place

Our government machinery is both out of order and out of date It is badly in need of repair and replacement It is uneconomical, inefficient, clumsy, and duplicates itself in many parts It should therefore, be repaired, where repairs are possible, and scrapped and replaced where nothing short of scrapping and replacement is possible

As to how this is to be done there is a wide difference of opinion Unfortunately, those in authority are not governmental mechanics Congress, composed of many good men and true, able and conscientious, is not made up of experts in running government machinery As a consequence, some of the remedies proposed are ineffective, some are weak, and some are vicious Some, if carried out, would do more harm than good

In repairing mechanism with a monkey wrench it *is common sense not to throw the monkey wrench into* the gears A watch which won't keep time cannot be *made accurate by taking it apart and putting it together* again with the same wheels in different places A reorganization of the government which merely rearranges existing parts, will not accomplish much What we want is not a shuffling of parts, nor even a replacing of some with other similar parts, but reorganization which will eliminate unnecessary duplication and waste of effort, money and time

Reorganization of our scientific work as well as of other parts of the government is a vital, pressing necessity But our scientific activities are too important to be man handled in ignorance, and too vital to our welfare to be tampered with without great consideration

The most common idea in regard to reorganization is that it should group related activities under one head in order to avoid waste The government supports a large number of chemical, physical, electrical and other laboratories "Why not," asks the legislator, "create a 'scientific bureau' which should control *all* these activities, allocate personnel, do the purchasing, and direct all the chemical, physical and electrical work of the government?"

In such a proposition lies a grave danger Any allocation of any government scientific work to any department, made without a most careful consideration of *all the factors* which *enter into the question* may be dangerous Scientific activities are *not similar functions* because *similar in nature* The Bureau of Mines makes researches into poisonous gases and gas masks *Chemical Warfare in the Army*, does exactly the same thing But the kinds of gases, the kinds of masks and the purposes of the two investigations are totally different To say that the two should become one, that the Army should do the mine work or the Bureau of Mines the Army work, is an absurdity

Much of our government machinery, like Topsy, "just growed" The spectacle of the Treasury saving lives of wrecked sailors, attending to prohibition and looking after the public health is matched by the picture our lawgivers painted when they put the Weather Bureau and Bureau of Public Roads under the Agricultural Department The legislator interested in economy sees this and asks "if the Coast and Geodetic Survey belongs under the Department of Commerce, why does the Geological Survey belong under the Interior Department? Both do surveying"

True enough, yet commerce is carried on in ships and ships need charts of our coasts, whereas the Geological Survey, interested in map making of the interior, has no function to perform as regards navigation

There is a tremendous overlapping of government scientific activities. Much of it must be eliminated, but if in eliminating the duplication we also eliminate what we created scientific bureaus for—the gaining of knowledge—we shall do more harm than good

Let us take a single scientific activity at random and follow it through our government machine Engineering research is a comprehensive subject which means much to us as a nation We are the world's premier builders and constructors We put up the biggest and tallest buildings, our elevators run faster and more safely than others, our trains cover more track, our concrete roads are better, our hydraulic labors are world models. All these and a thousand similar activities are the result of engineering research Some of that research has been done in government laboratories

The War Department does engineering research in the United States Engineering Office, in the Mississippi River Commission and in the California Debris Commission In the Treasury Department the Supervising Architect has some to do, as does the Public Health Service Yards and Docks and Engineering in the Navy Department, of course, make independent engineering researches and the Interior Department has engineering laboratories in the Bureau of Mines, Reclamation, Geological Survey, the Alaskan Engineering Commission *and the Division of Capitol* Building and Grounds The Weather Bureau, Public Roads and Forest Service in the Agricultural Department, the Bureau of Standards, the Bureau of Lighthouses, the Coast Survey and the Bureau of Navigation in the Department of Commerce—all have their engineering offices and laboratories and four of the independent units of the Government (not attached to or a part of any department) have similar activities: the Interstate Commerce Commission, the International Joint Boundary Commission, the Shipping Board and the Panama Canal Board

Twenty two different offices and bureaus then, make engineering researches for Uncle Sam "Horrible," says the efficient Congressman "Let us create an Engineering Research Bureau' and *transfer all these* activities to it"

But the *sort of engineering research* which is done by Yards and Docks would have no relation to that in which Reclamation is engaged Boundary work engineering involves the channels of rivers and the shores of lakes, so does the engineering done by the War Department's Board of Engineers for Rivers and Harbors But the latter is done with an eye to efficiency, doing public work with publicly paid army engineers, giving them practice against the need of war engineering and allowing them so to labor that our rivers and harbors may be available as means for defense Are you, Mr. Legislator, going to take this from their hands and give it to the Boundary Commission, or will you involve the Army in boundary disputes?

The question is not so easily settled after all. A mere listing of similar activities does not prove them nearly enough related to demand unit control Because the same thing is produced by two different agencies of the government is no real reason for combining these agencies Twenty-four different offices in the government do surveying, or mapping or charting, or all three Many of them could be combined in one office, to the betterment of the making of the maps and charts and a reduction in cost. But it is unthinkable that *all* of them cauld The three largest map-making establishments of the Government are the Coast and Geodetic, the Geological Survey and the Hydraulic Office of the Navy *If they were all* combined in one grand chart making establishment the initial cost of making charts would be reduced. But the efficiency of chart using would also be reduced. A civilian production is rarely as good for a military purpose as the same thing produced by military authorities. The Navy has found it essential to its efficiency to make its own guns its own sea planes, its own officers, its own yards and docks, its own ammunition. Why should it be supposed that the Navy would not find the ends of efficiency best served by making its own charts?

"All right, then," says the economy hunting Congressman, "we'll make a great chart bureau and put it all under the Navy. How will that suit?"

It won't suit. What does the Navy know about Geological research? What does the Navy know about the needs of the *Land Office*? What tie is there between the Navy and Reclamation? None.

The *principle on which too many organizers of the* Government are working, is that the end to be served *is purely one of economy*. It is *not*. Although the American people are anxious that their government engine shall be run economically, they are also desirous to get value received for its running It is when it is *both* expensive and inefficient that we kick Reorganization will fail if efficiency of *use* of a government product is not obtained. Economy of operation which destroys efficiency of use, will injure us far more than we will benefit by the saving of a few dollars of appropriation

An instance to the point is the proposal to take the Naval Observatory from the Navy and put it under the Department of Commerce. The theory, apparently, is that one of the great functions of the Observatory is the provision of standard, accurate time; that time belonging to us all, is the basis of all commerce, that, therefore, the agency providing it should be under the Department of Commerce On the same theory, powder for guns, a product of mines, should be produced by the Bureau of Mines, and sextants, being instruments of precision, should be produced for the Navy by the Bureau of Standards

The Naval Observatory, even if under Commerce, would still have to depend upon the Navy to send out radio time signals, and it is probable that the Navy would immediately find funds somewhere for the equipment of a new observatory of its own (if this one were taken away from it) to be able to be responsible for its own Nautical Almanac, on the accuracy of which depends thousands of lives and millions of dollars of Naval property

Another instance is found in the subject of education Education is a government *function*, and educational work a vast activity of the United States Government Fifteen *separate agencies of the Government do* educational work "Combine them!" cries the economist "Get them all *together* and let them teach *mightily*, because united, instead of weakly, as they must do while separated"

Undoubtedly the Government should have a Board of Education Some believe it should be a department with a cabinet officer at the head. Undoubtedly it could, and should, look after educational matters which are educational first, and of special effect afterward But to take the agricultural education of farmers out of the hands of the Agricultural Department, or the education of Army and Navy officers out of the hands of the Army and Navy, or the promulgation of the principles of hygiene out of the hands of the Public Health Service, would be a stultification of purpose for the sake of economics of purse. This is never economy in the long run

Enough has been said to indicate the general trend of objection to a wholesale reorganization of the Government on a plan which contemplates putting similar activities together under similar control for the *one* reason that they *are* similar and on the theory that the similarity affords an opportunity for economy of appropriation and administration regardless of the economy of the results.

If the objection is well taken and sustained by common sense, then ***the only possible principle upon which a successful reorganization can be effected is that already outlined: the economy of the use of the product combined with the economy of its manufacture or administration.***

A New Era In Wireless

What Is Being Done With the Radio Telephone By Way of Broadcasting News, Music and Sermons

By L. H. Rosenberg

FOR years commercial stations have been using the wireless telegraph successfully and amateurs, experimenting with the art, have spent hour after hour on this interesting subject. The mystery of the dots and dashes received from the ether after having traveled hundreds of miles, has interested thousands, and many boys and even grown men have painstakingly spent hours in order to master the wonders of radio and to learn perfectly how to send and receive code messages.

But now there is a new era, and we have radio in a new rôle No longer is this fascinating subject confined to the expert, for today all may enjoy its many benefits. Radio telephony has developed to such an extent that one does not need to be an expert to receive the messages of the air

From many plants all over the United States music and actual talking can be picked up as broadcast from efficient broadcasting radio telephone stations. One of the most successful of these stations is the experimental broadcasting station of the Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pa. Concerts are given nightly from this station and they are heard over an area of three million square miles In this territory there are hundreds of thousands of persons who hear these concerts The programs for the evenings usually consist, in the main, of phonograph music and national and international news The great success of this scheme which is attracting wide attention, is the care taken in the selection of the program For instance, a careful study has been made of phonograph music Records which sound exceedingly well when played on the ordinary talking machine may be entirely unsuited for this character of music The best records are tenor and contralto solos and it has been found that instrumental music such as the xylophone, saxophone, the accordion and the cornet are very clear The program for each night is carefully considered and a selection is made of instrumental and vocal, classical and popular

Not only is phonograph music transmitted from this station, but the sending out of a complete church service is the feature of each Sunday night In the church and pulpit of the Calvary Episcopal Church of Pittsburgh are installed several transmitters These transmitters are connected to a private telephone line which runs to the radio station seven miles from the church When the choir sings, or the rector preaches these transmitters respond to the sound waves and the music or sermon, as it may be, is transmitted to East Pittsburgh via the telephone line There it is broadcast by means of the radio apparatus, thus allowing thousands of people to hear the service in their own homes Think what this means to many people the invalid, unable to go to church can enjoy its benefits without leaving his bed or wheel chair, the farmer, too far from town to go to church has the service brought to him; and the sick in the hospital are encouraged to get well by the wonderful words of the preacher It is marvelous, this transmitting of church services by radio One can almost imagine being in church The blending music of the sixty men and boys lifted in song and the ring of the deep set voice of the preacher all make the service seem realistic

So many of the innovations with radio have proved successful that the possibilities of the radio broadcasting plan seem unlimited When Herbert Hoover visited Pittsburgh to tell his story about the starving children in Europe, arrangements were made for sending this appeal broadcast by radio A special speech was not necessary Immediately in front of Mr Hoover at the dinner, held at the Duquesne Club, was a transmitter It was arranged in such a manner that it was unseen by both Mr Hoover and the audience but this did not prevent it from working perfectly Instead of making his plea to one or two hundred men gathered at dinner, Mr Hoover was able to reach thousands of people who stayed at home listening to their wireless receiving sets

A short time ago Prof Vladimir Karapetoff, professor of Electrical Engineering at Cornell University, who is also a noted musician, gave a lecture piano recital at the Westinghouse Club Although this event was held in a large hall, the attendance was limited Here was wonderful music and a discussion of the great composers, which were limited to hundreds—that is it would have been limited to hundreds if it had not been for the wonder of radio broadcasting

Besides the transmission of the concert music, the church service, the speech of prominent men, broadcasting of a more material nature is forthcoming The farmer can receive the crop report at the present time; this is sent from Washington, D C, and the tired business man can get the high points of the latest news When he gets his morning paper, if he lives in the city he reads more about the happenings given in brief the previous night by radio

And let us predict further When the radio broadcasting has reached a higher stage of development and is more fully utilized, the benefits will be enormous It will be like a three ring circus If you look in one direction, you see clowns performing antics, or you may see acrobats, chariot races and what-not

Soon in radio you will be able to get popular music if you desire, or classical music, or church service, or speeches, or crop reports or news These will all be sent out at the same time and it will merely be a question of 'looking in the proper direction" for the reception of your choice This will be accomplished by transmitting in what is known as 'wave lengths"

One wave length will convey one kind of entertainment, and another wave length will convey another kind By a simple adjustment of the receiving apparatus, any wave length reception may be selected

The apparatus necessary to receive this radio broadcasting is exceedingly simple and can be purchased from a few dollars up, depending on the quality of reception desired and the distance from the broadcasting station

The original idea of the necessity of the telephone headset has been bettered and now by the addition of a loud-speaking horn to a good set of apparatus, many can hear the broadcasting from the same outfit.

Although much has been done with respect to these radio telephone experiments, in a few years we will wonder that we were ever able to exist without enjoying its many benefits

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Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

That Non-Skid Horseshoe Prize

To the Editor of the SCIENTIFIC AMERICAN.

In your paper for March 19, 1921, you published a communication from George Foster Howell, on page 227 of the SCIENTIFIC AMERICAN, showing that our Association is offering $500 for the most satisfactory non-slip horseshoe or device Mr Howell writes me that he distinctly wrote $1,000 It strikes me that if you could manage to give the space it would be well to give the following details of the competition·

1 The competition is open to all without restriction

2. The Association reserves the right to reject any or all designs submitted and to make final decision on award.

3 A committee of three, appointed by the President of The American Humane Association, composed of one prominent veterinarian and two practical horsemen, of large experience, will examine the designs submitted and report on the same with recommendations to the Association.

4. The design may be submitted by means of drawings or a model, or both A description should accompany each design submitted, stating in detail the merits claimed for the invention, the materials used or proposed to be used in its construction, and its estimated cost. State whether or not the invention is in actual use or has been tested, and the results as to wearing record, non-slipping qualities, and other advantages Such descriptive matter should be typewritten.

5. Each sheet of drawing and each model and all descriptive matter shall be unsigned, but shall bear a device, number or motto for identification; and the same device, number or motto shall be placed on a sealed envelope containing the competitor's name and address This will not be opened until the award has been made In making the award, the cost of the device, its wearing qualities, and all other points of merit will be taken into consideration, in addition to its non-slipping qualities

6 Drawings and models with the accompanying envelopes must be securely packed or wrapped and delivered at the office of The American Society for the Prevention of Cruelty to Animals, Madison Ave and 26th St, New York, before 6 o clock P M, July 1, 1921

All inquiries regarding this competition should be addressed to

DR WILLIAM O STILLMAN,

President The American Humane Association, 287 State St, Albany, N Y

How Does a Cat See in the Dark?

To the Editor of the SCIENTIFIC AMERICAN,

I noticed the other evening in a fairly well lit up-room a cat sitting near the door waiting for it to be opened so that she could go out There was nothing in particular about the door to see or for the cat to concentrate her mind on except merely to want to get out, so that she could not have experienced any eye strain A cat's eyes, in good light, are of a yellowish color This particular cat appeared to have black eyes, and that is how I came to notice her in particular

Observing a little closer, I noticed that the darkness of color in her eyes was due to a complete opening of the iris diaphragm In a cat's eye the diaphragm opens more than in eyes of some other animals, including the human eye, so that I would judge in the language of photo-optics that the aperture in the eye of this particular cat was approximately F-1

I am certain that the diaphragm aperture in the eye of the average man would, under the same conditions of illumination, be approximately F-4 Inasmuch as the amount of light that entered the cat's eyes would therefore be sixteen times more than would have entered the man's eyes, it probably indicates a retina sixteen times less sensitive. If this is so how can her catship see in the dark where a man cannot It may be said that a cat's eyes are more sensitive to perhaps the infra-red rays, or perhaps she sees by them altogether This, however, appears doubtful, for the reason that artificial illumination is particularly rich in these infra-red rays in which the cat found it necessary to absorb much more light than a man would This cat further proved that if she opened her diaphragm to full capacity under such good light she must have had little or no further resources in a comparatively dim light, and therefore, could not see nearly so well as a man could in a similar dim artificial light

Under the circumstances above described the cat must have seen objects also much wanting in focal definition.

A F SHORE

New York

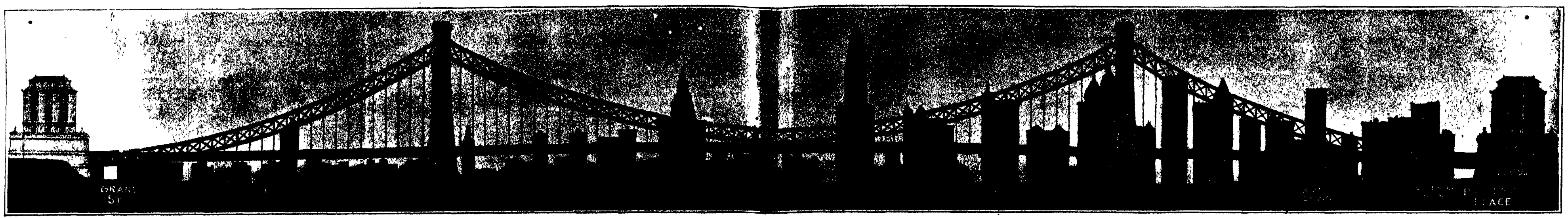
Electromagnetic Waves in a Moving Magnetic Field

To the Editor of the SCIENTIFIC AMERICAN,

Gilbert showed that the earth is a great magnet, Faraday that every magnet is surrounded by a "field of force" As the earth is a "body in space" and is known to have a magnetic field it seems reasonable to suppose that the other bodies in space have such fields. Eclipse observations indicate that this is true for the sun When Maxwell proved that light was an electromagnetic phenomenon I thought a moving magnetic field should affect it, that light in passing among the bodies in space would not move in straight lines on account of their magnetic fields To test the theory a special form of interferometer was designed and ordered from Gaertner of Chicago It divided a beam of light into two paths at right angles In one path a powerful rapidly revolving magnet was placed As the light was affected the results were published years ago in *The American Journal of Science* As recent eclipse observations appeared to show that light was affected in passing near the sun, Einstein's theory that the effect is caused by the attraction of the sun's gravitational field is receiving much attention from your readers It is therefore desirable to bring my forgotten theory and experiments to their attention, for some, at least, of the observed deflection is due to the sun's magnetic field

WILLIAM ROLLINS.

Boston, Mass



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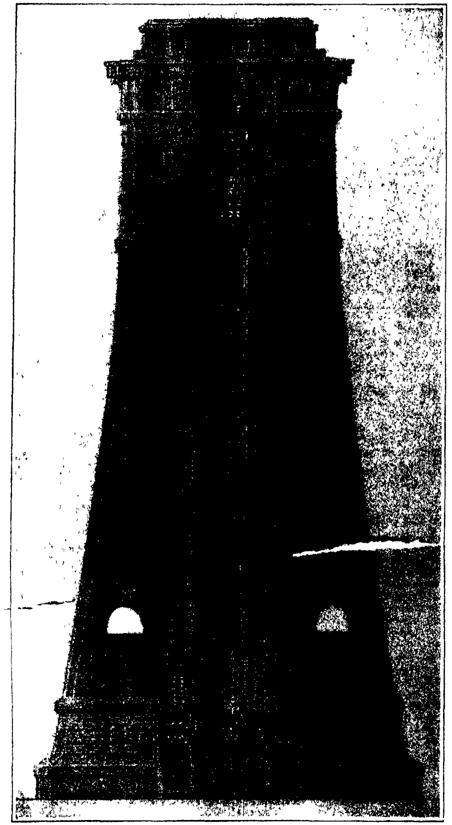
Hudson River Bridge, drawn to scale, imposed upon the skyline of New York. If one anchorage were placed at the Battery, the other would stand to the north of Grand Street. The bridge would dwarf even the towering office buildings of lower Manhattan



The Woolworth Building, 151½ feet by 792 feet, looks slight against the bridge tower, 400 feet wide by 840 feet in height

A Study in Magnitude

Comparison of the Hudson River Bridge with Some of the World's Largest Constructions in Engineering and Architecture

By J. Bernard Walker

COMMENTING in a recent issue upon the unprecedented magnitude of the Hudson River Bridge, we stated that it was not idealism or any striving after the spectacular that led to the conception of this bridge upon such a gigantic scale. We showed, on the contrary, that its dimensions have been determined by the severest application of the principles of economy, since in all constructive engineering work it has been proved, particularly in recent years, that there is economy in concentration. It is because of the reduction both of the first cost and of the cost of operation, which will be secured by carrying the transportation between the Western continent and Manhattan Island on a single bridge, that the Hudson River structure has been planned upon its present stupendous scale.

The main outlines of the bridge, as at present determined, call for a total length from anchorage to anchorage of 6,660 feet, divided into two shore spans each 1,710 feet long, and a central span across the river of 3,240 feet. Including anchorages the length is 7,460 feet. The roadway, 220 feet in width, will be suspended from four steel chain cables, each consisting of 80 lines of eyebars arranged in three banks and enclosed in a watertight tubular casing of bronze plating, whose diameter will be fifteen feet. The upper deck will consist of a broad automobile and motor-truck roadway 155 feet in the clear, and there will also be provision for two trolley line tracks and two 17-foot walks for passengers. On the lower deck will be ten trunk railroad tracks.

The Bridge and New York's Skyline

We have heard a great deal lately about relativity, and in the endeavor to convey a quick impression of the great height and length of the Hudson River Bridge we have selected the skyline of lower Manhattan, from above Grand Street to the Battery, as a basis of comparison. The view at the top of this page represents the skyline, as it would appear if drawn to exact scale without any foreshortening by perspective. The heights and widths of the various buildings are also drawn to scale; and upon this drawing we have imposed the big bridge, drawn to the same scale and placed in the same vertical plane. We confess that the result is surprising. If one anchorage of the bridge were built at Battery Place abreast of the Customs House, the first tower would be abreast of the Singer Building, the second tower just to the north of the New York Life Insurance Company Building, and the other anchorage would cover half of the block to the north of Grand Street, the total length, including anchorages, being 7,460 feet. In a comparison of vertical height we find that the anchorage at Battery Place, 500 feet in height, would overtop the Whitehall Building by 84 feet, and that it would be exceeded in height only by the Bankers' Trust Building, 540 feet, the Equitable Building, 537 feet, the Singer Building, 612 feet, and the Municipal Building tower, 580 feet. The two main towers, each 840 feet in height, would have a margin of about 50 feet over the Woolworth Building, whose extreme height to the top of the finial is 792 feet. Many of us remember the time when the dome of the World Building stood higher above the street level than any other structure in New York. Yet today the upper cable of the bridge at its lowest point in the main span would stand about level with the top of this dome.

The End Anchorages

The function of a suspension bridge anchorage is to resist the horizontal pull of the cables. This, in the Hudson River Bridge, amounts to 260,000 tons. Resistance to this pull with a wide margin to spare, is obtained by building the anchorage of such size and weight that the frictional resistance to movement between itself and the ground is sufficient to hold the cables taut and do so with a sufficient friction in reserve to prevent the slightest movement. The engineers' calculations call for a mass of masonry measuring on its base 400 feet in the direction of the length of the bridge, 375 feet in width, and 220 feet in height, while upon this base will stand two office buildings 70 feet in width, 250 feet in length and 280 feet in height. Looking along the axis of the bridge, there will be a space of 100 feet between the inner faces of these buildings. On the two anchorages there will thus be four modern office buildings, which will contribute considerably to the annual receipts from the bridge.

The Main Towers

In order to secure sufficient height to give the chain cables the proper curve or catenary and also to secure a well-balanced architectural effect, it was found necessary to carry the main towers up to a full finished height of 840 feet. Also, to secure sufficient breadth to give stability, it was necessary to make the base of the towers 200 feet in depth by 400 feet in width. From this base the towers rise with a very pleasing curve to the summit, where they measure 100 feet in length by 200 feet in width. It should be understood that the structural part of the towers, which carries the load of the cables, is not visible. Externally the towers are of granite, but this stonework is merely a covering for the internal, very massive and strongly braced steel towers which carry the load of the cables. The external masonry walls were adopted, partly *for their architectural effect*, but principally to act as a protection for the internal steelwork. This protection will be so complete that one painting of the towers will be good for a period of at least a decade.

At a height of 170 feet above ground level, the tower will be pierced by three arches, a central arch 150 feet wide and 100 feet high, and two side arches each 30 feet in width. In the center of the face of the tower will be a round arch window 120 feet in width and 275 feet in height. Its framework will be of steel and it will be filled in with heavy wired glass. The purpose of the windows is to light the interior; also, of course, they add to the architectural effect by breaking up the vast blank front of the tower. The total weight of steel in each tower will be 35,000 tons.

In order to give an adequate impression of the great height and bulk of the Hudson River Bridge towers, we have shown one in elevation, and upon it our artist has drawn to exact scale the front facade of the Woolworth Building. The illustration speaks for itself.

The Floor of the Bridge

On an equal scale of magnitude with the rest of this great structure is the double-deck, suspended floor of the bridge. On the upper deck, on the extreme outside, will be two 17-foot passenger footways. Adjoining these will be two tracks for trolley cars. Between the cables will be found one of the greatest boulevards in the world—a clear, unobstructed roadway 155 feet in width and 12,000 feet in length, if we include the approaches. Entrance to this roadway commences near Ninth Avenue, New York. The anchorage will be pierced by three arches, one central arch 150 feet wide by 100 feet high, and two 30-foot side arches. The roadway will be covered with asphalted concrete. It will be absolutely watertight, and its broad surface will

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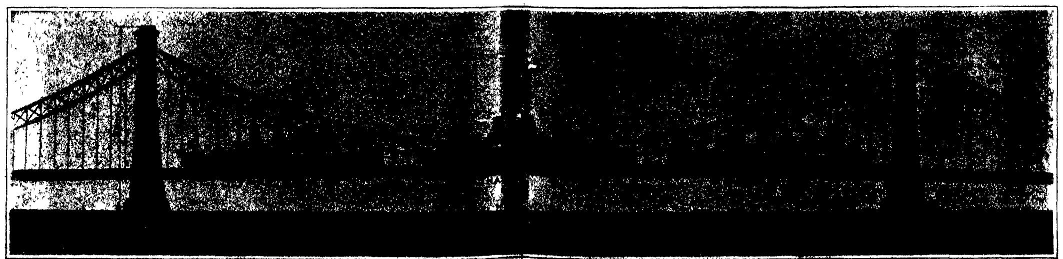
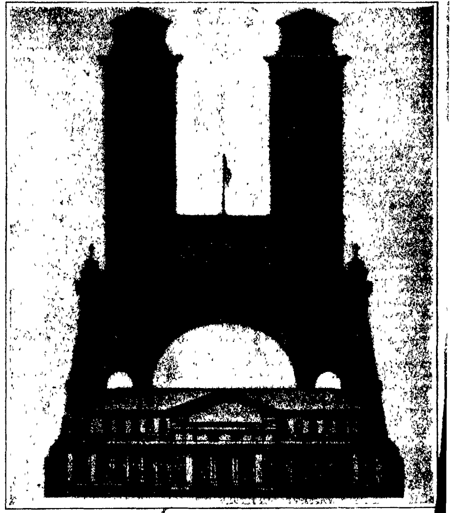
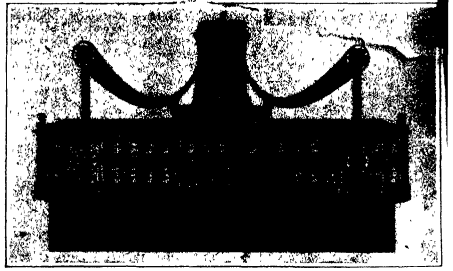


The main span, 3240 feet in length, could accommodate three of the world's largest steamships, with 400 feet to spare. Although their combined weight is 160,000 tons, it would fall far short of the weight of the main span



An anchorage compared with 42nd St. Public Library. Width, 375 feet; depth 400 feet; height to top of office buildings, 500 feet



So wide is the bridge (220 feet) that the City Hall, New York, could rest upon its upper deck, with a few feet to spare

The Heavens in June, 1921

How the Study of Radioactivity Gives Us a Yard-Stick to Use on the Years

By Professor Henry Norris Russell, Ph.D.

IT has long been realized by all students of nature that the duration of the universe in time, like its extent in space, must be exceedingly great. But when it comes to attempts at measurement, it is a far harder matter to deal with time than with space. The simple and powerful geometrical methods for the measurement of great distances have no analogues when it comes to great intervals of time, and thus, though we can determine, with fair precision the distances of extremely remote stars, it is still by no means easy to estimate the age even of the planet on which we live.

Some Geological Dicta

Some idea of the age of the earth can be got, of course, from geological evidence. To wear away the mountains, and carry their debris into the sea to form new sedimentary strata, must have taken millions of years at the very least; but when we try to figure out how many millions, we have great troubles in making even rough estimates of the total quantity of material that has been worn away, and of the rate of weathering and erosion. What is worse, we have very little idea whether the rates at which geological processes are going on today are similar to the average rates which have prevailed throughout geologic time, or whether present conditions are exceptional. It can be calculated that, if the rivers of the earth had always carried into the sea every year the same number of millions of tons of dissolved salts as they do now, the whole existing salt of the oceans would have been accumulated in about seventy million years. But this is a big "if," and some able geologists, notably the late Professor Barrell of Yale, believe that the present rate of transfer of the salt to the sea is unusually rapid, and that the age of the earth is therefore greater than the figure named.

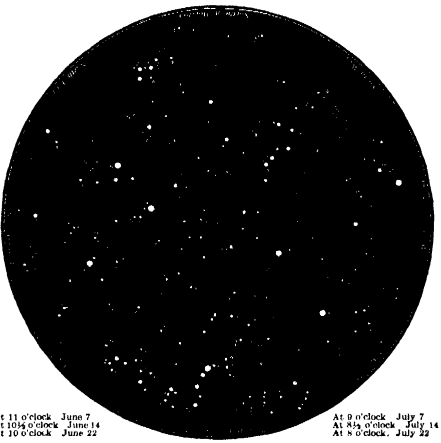
Lord Kelvin calculated many years ago, from the internal heat of the earth and the known conductivity of rocks for heat, that it could not have been more than twenty or thirty million years since the earth was red hot out to the very surface —otherwise it would have cooled off more at a depth of a mile than it actually has done. But this calculation assumed that the earth was losing heat at its surface while no heat at all was being produced in the interior. This was the only assumption that seemed reasonable when Lord Kelvin wrote; but since then radioactivity has been discovered, and it is known that the radium in the rocks of the earth's crust (with the parent uranium which keeps up the supply of the shorter-lived radium) is steadily generating enough heat to account for all that is lost by conduction to the surface, and that it will continue to do so for billions of years. So the argument from cooling falls out altogether and the problem must be attacked afresh.

The theory of radioactivity has at last, however, furnished us with a real foothold for our estimates of great intervals of time. We know that the heaviest atoms, such as that of uranium, are slightly unstable. A certain proportion of them break up every year, expelling an alpha particle with enormous speed—which ultimately contributes enough energy to heat the surroundings—while the residue of the atom settles down into an atom of a new kind. These new atoms again undergo similar changes, and so on through a long series of processes—radium being only one member of this family. *When a steady state has been attained,* each of these intermediate substances occurs in a definite proportion—the supply being kept up by the disintegration of the next preceding member of the list exactly as fast as it is depleted by the breaking up of the substance being itself considered. The more rapidly changing substances will evidently be present in smaller proportions. Now it is found by direct analysis that the quantity of uranium in a mineral is always about 3,100,000 times as great as the quantity of radium. It follows that the percentage of radium atoms that break up every year is 3,100,000 times as great as the corresponding percentage for uranium atoms, *and hence that the average life of an atom of* uranium is three million times as long as that of a radium atom.

Now the latter can be found by direct investigation of various kinds, and it is known that the "half-period" of radium is a little over 1,600 years. That is, if we have today any given quantity of radium, at the end of 1,600 years half of its atoms will have been disintegrated, and only half the radium will be left. After another 1,600 years half *this remnant will have* vanished, and so on indefinitely. The corresponding "half period" for uranium is 3,100,000 times as long, or nearly five billion years.

The Age of the Earth's Crust

Here at last we have got hold of a process that is slow enough to serve as a measure of great intervals of time, and yet such that, by the fortunate possibility of comparison with radium, we know with decent accuracy the rate at which the slow process takes place. As a first example of its utility, we may take the age of minerals and rocks. After the long set of changes, the uranium-radium series settles down into an apparently stable type of atoms, with the properties of lead. It is not ordinary lead, though; for while its chemical properties are the same its atomic weight is different—206 instead of 207—and careful analysis will detect the distinction. Suppose now that we set aside a quantity of uranium (or some of its compounds) enclosed so that nothing could escape or be added to it. After 80 million years, a little more than one per cent of the uranium would have "decayed" and the disintegrated atoms, after running through their changes, would have settled down as lead—losing a little weight *on account of the particles shot out* from them during the changes. If after this time we could make an analysis of the material, originally chemically pure, we should find just one per cent as much lead as uranium in it. The lapse of another eighty million years would find the lead increased to nearly two per cent of the uranium, and so on.



At 11 o'clock June 7
At 10½ o'clock June 14
At 10 o'clock June 22

At 9 o'clock July 7
At 8½ o'clock July 14
At 8 o'clock. July 22

At 9½ o'clock June 30

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY

Now we cannot wait these millions of years to watch our experiments, but nature has kindly started similar experiments for us, by forming crystals of minerals, rich in uranium, in rocks of great geologic age. All through the ages since they were formed the uranium in these crystals has been decaying, and lead has been forming; and from an analysis we can work out how long the crystal has been there, sealed in the rock. The values so obtained for the ages of various rocks agree in general with the geological record, rocks geologically young showing little lead in proportion to the uranium. Much careful work has been done on this line by various investigators. What interests us most at the moment is the age of the oldest minerals. Specimens from various countries in Europe, Africa and America have been found which appear to be between 1,000,000,000 and 1,200,000,000 years old. They are all from rocks of great geological antiquity (Middle Pre-Cambrian), but according to Professor Barrell, who collected these data, they are probably far from representing the original material of the earth's crust (if indeed any such remains). The evidence therefore appears to be convincing that this world of ours is at least a billion years old.

The Upper Limit

But how much older than this may it be? Can we set any limit at the other end, and say that the earth is younger than this figure?

The present writer has recently made an attempt, based upon another assumption of radioactivity. Joly, the Irish physicist, has shown from analysis of many rocks, made by the exceedingly delicate methods which detect radioactive substances, that, on the average, the proportion of radium in these rocks is about *one part in 400 billions, by weight.* To keep this radium there there must be fully three million times as much uranium, or seven parts of uranium per million parts of rock.

Now this uranium is steadily disintegrating, and so far as is known to science there is no way in which uranium atoms are being formed. There is no heavier known element to break up and form them. Hence the present quantity of uranium must be only the shrunken remnant of a greater quantity which was once present. Five billion years ago there must have been twice as much; ten billion years ago twice that, or four times the present amount and so we go, doubling every time, until we find a thousand times the present amount 50 billion years ago, and 85 billion years ago come by calculation upon a world made entirely of uranium.

But we must not push our reasoning so far. The uranium which was once there and has changed has doubtless changed into lead. From the amount of lead now present we can figure out the amount of radium originally needed to produce it. According to Clarke, of the U. S. Geological Survey, the average proportion of lead in ordinary rocks is twenty-two parts per million. This corresponds to 25 parts of uranium originally present. Add the seven parts which are still there, and we have an original content of 32 parts of uranium per million, which has died down to a little less than one quarter its initial amount. The time necessary for this is eleven billion years.

But this is too high an estimate, for all the existing lead cannot have been produced by the decay of uranium —the atomic weight is different. We must allow, too, for the fact that there is thorium in the rocks—another radioactive element, which also decays ultimately into a different sort of lead, with an atomic weight of 208. Making allowance for the thorium (*now 30 parts per million according to Joly*) we find that the existing lead could have been produced by the uranium and thorium combined in eight billion years. The mixture of the two kinds of lead would give an average of about the right atomic weight for "ordinary" lead. But of course we cannot be sure that all the "ordinary" lead originated in this way. If it did not, our estimate is too high—but that is the proper direction for er[illegible] take in computing an upper limit.

However [illegible] may be, we face a very interesting situation. [illegible]lations based on well-known principles

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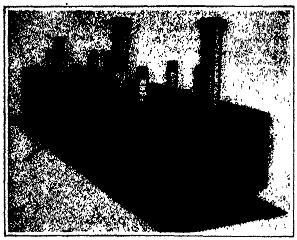


The entire flight of locks is shown in miniature on this control board

The Canal Lock Switchboard

FOR controlling the locks of the six-mile industrial canal being built for the Port Commission of New Orleans, a small electrically operated miniature canal switchboard has just been perfected Quite out of sight of the canal itself, one man as operator can control the movements of the lock machinery and have before his eyes just what is happening on the actual canal when he turns the control handles

The miniature canal, or control board, is 16½ feet in length, and is rated at 110-220 volts In solving the problem of lock control, the engineers so designed the switchboard as to show in miniature the actual operation of all main apparatus, also to indicate the level of water in the lock chambers and the position of all water valves

The switchboard shows the lock chambers of the canal by a stretch of marble slabs, extending from one end to the other of the control board At various points along the line of this miniature canal, columns rise to various heights These columns are scaled for reading, and indicate the rise and fall of water in the lock chambers when the operator, by means of the control handles, opens and closes the water gates in the actual canal.

On the top and near the edges of the board are located the control handles These handles are operated through an angle of 90 degrees They open and close the circuits to the electrical apparatus which works the lock machinery, located in the walls of the locks Name plates show the "open," "close," and "off" positions of the handles.

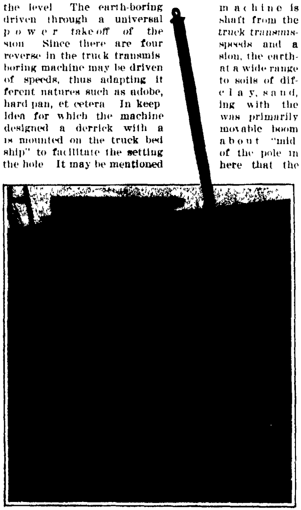
A special arrangement was worked out to take care of the question of interlocking A series of vertical and horizontal bars is provided, the bars moving in a di-

(*Continued on page 460*)

The Earth-Boring Machine

IN 1914 when the first transcontinental telephone line was being constructed, there arose the necessity of an improved method of boring holes for poles A survey of the field for available machines was made with the result that a power driven auger mounted on the rear end of a horse-drawn wagon was purchased and put into use. This machine was powered by a four-cylinder gasoline engine and required a team of four horses to draw it through the territory encountered This method of locomotion was slow indeed, and difficulties were invariably experienced when holes were to be spotted

The limitations of their machine were apparent to the company officials, who set out to develop something better—and with a success revealed by our photograph The power-driven earth-boring machine is mounted on the front end of the chassis of a motor truck Because of the fact that the pole line invariably extends "cross-country," a truck having four wheel drive is absolutely essential to enable the truck to negotiate the surface encountered in plowed fields, irrigation ditches, and the like The mounting of the boring machine is such that it is possible to bore a vertical hole with the truck on any negotiable grade, it is also possible to bore a hole at any angle up to 45 degrees from the vertical, with the truck on the level The earth-boring machine is driven through a universal shaft from the power takeoff of the truck transmission Since there are four speeds and a reverse in the truck transmission, the earth-boring machine may be driven at a wide range of speeds, thus adapting it to soils of different natures such as adobe, clay, sand, hard pan, et cetera In keeping with the idea for which the machine was primarily designed a derrick with a movable boom is mounted on the truck bed about "midship" to facilitate the setting of the pole in the hole It may be mentioned here that the pole is set with cross-arms bolted in place, thus effecting a saving of time, as it is much more convenient to bolt the cross-arms in place while the pole is on the ground The same advantage is to be gained in the case of guy wires



The post-hole auger mounted on a motor truck

The controls of the earth-boring machine and derrick are situated within easy reach of the truck driver, which obviates the necessity of changing his position to operate either the earth-boring machine or derrick, or of the necessity of having a separate operator for the operation of the earth boring machine and derrick

The driver spots the point of auger on the surveyor's stake and sets the brakes on the truck, shifts the compound gear of the truck to neutral, and pulls in the clutch on the earth-boring machine The auger is fed

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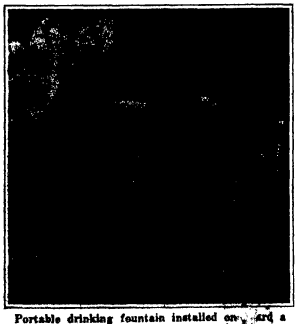
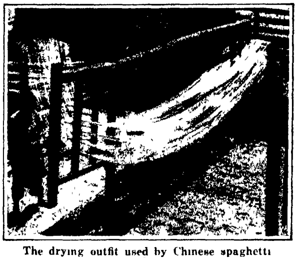


Portable drinking fountain installed on board a tank ship during her construction

Bringing the Drink to the Job

THE necessity of having to quit the job and go ashore for a drink, or the equally inconvenient alternative of having a bucket boy wandering about the job, was found irksome to the men and expensive to the contractor engaged in building a tanker in an Oakland, Cal shipyard So the inventive jack-of-all-trades who is to be found on every such job as this one got busy, with the result pictured Two 2 by 4 planks were bolted to the side of the vessel, with a third placed across them Two fountains of the ordinary variety were attached to the plank, and hose was run from them to the nearest source of water supply on shore. In this manner the men on the ship were able to satisfy their thirst with ease and without loss of time—By *C W. Geiger*



The drying outfit used by Chinese spaghetti makers

Chinese Spaghetti

SPAGHETTI we ordinarily associate with Italy; and most of us have probably heard the tale of the American lady driving through Naples, who went into ecstasies over the delightfully artistic window curtains to be seen throughout the city, only to learn that she had been admiring the home-made batch of Italy's national food, hung in the front windows to dry as per long established custom But China, too, has her spaghetti, or at least her foodstuff so similar to spaghetti in composition and preparation that we may employ the name The methods of drying it are a trifle different however, as our photograph shows So far as the picture goes, it would be easy enough to impose upon the reader and tell him that this is one of the processes of oriental silk manufacture, but we are assured by the photographer that the slant-eyed workman is really engaged in the preparation of something to eat rather than something to wear—By *James Anderson*

The Surveying Searchlight

ECONOMY in the consumption of storage battery power as well as continuous employment for surveying parties in fog and smoke and even making possible night observations are the notable advantages of a signal lamp of highly-concentrated reflecting powers recently designed by E G Fischer, chief of the instrument section of the United States Coast and Geodetic Survey The high-powered light is a modification of a previous design which was an accompaniment of the theodolite in surveying lines up to 150 miles in length, the more recent lamp lessening considerably the number of dry cells required and is adapted to measuring angles of triangles, the sides of which are from 10 to 100 miles in length

The newly-built signal lamp will displace the acetylene lamp, storage cells, oxy-acetylene outfits, and motor-generator sets, all of which are subject to be discarded by reason of their bulkiness, cost of maintenance, or unreliability Surveying and mapping the entire country is one of the functions of the United States Coast and Geodetic Survey, city, county, and State surveyors looking to this government bureau for

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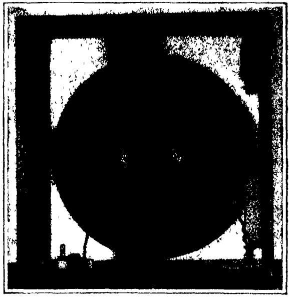
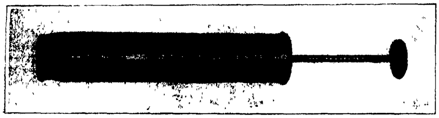


The surveying searchlight that throws 17,500 candle-power 100 feet

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



A pump-like device with a screened container for holding the parts of a watch that are to be washed and cleaned

Simplifying the Cleaning of Watches

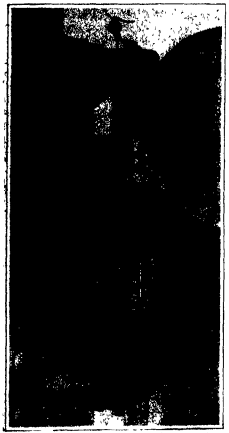
BY making use of the usual hand pump principle, Bert McCarty of Tampa, Fla, has developed and patented a device that simplifies the work of cleaning watches The device, which is shown in the accompanying illustration, consists of a simple hand-pump fitted with a screen receptacle at the bottom, in which are placed the parts of the watch to be cleaned The pump is then placed in any liquid that is to do the cleaning, and the pump is operated so as to pass the liquid through the screened receptacle A more elaborate form of this device has a number of compartments in order that all parts can be washed at the same time, for instance, the heavy plates are placed in one receptacle, the small springs, screws, blocks and so on in another, the balance, fork and train wheels in another, and so on In this manner more pieces can be washed at a time, while there is no danger of their damaging each other

The Swimming Collar for the Beginner

THE main difficulty in the way of learning how to swim is that the novice's head goes under the water, causing fright and the loss of confidence Now comes an American inventor with a swimming collar which eliminates the usual ducking and makes swimmers out of novices in short order, according to the claims

The swimming collar, which is shown in the accompanying illustration, is a high, transparent, celluloid, cylindrical collar made water-tight at the bottom through the use of rubberized fabric that fits snugly about the neck. The top is also made of rubberized fabric and has breathing holes. The collar is quite light, weighing but seven ounces and floating like a cork upon the water It lifts the head when in the water with a buoyancy of about ten pounds, therefore keeping the head from sinking.

The swimming collar which prevents the swimmer's head from going under water



A device that indicates the gravity test of gasoline and the condition of pumping station

A Check on the Accuracy of the Gasoline Pump

AFTER several years of experimental work on a gasoline pump tester, an American manufacturing company has finally succeeded in developing the commercial model shown in the accompanying illustration This device is designed for attachment to an invisible gasoline pump, and converts this type of pump into a visible one

For years, it is claimed, the public has paid for gasoline that it never received This has taken place perhaps unwittingly by some dealers, owing to their lack of knowledge of the essentials of the installation of their pumping system Inspectors and sealers of weights and measures have known for some time that there should be some device that would indicate to the public the condition of the pumping system, and also that it would help them to condemn pumps with faulty installation and place the gasoline pumps before the public with better accuracy

The new device is claimed to remove these existing evils It is made in four types, namely, one without a float indicator, one with a float indicator, one with a correct reading, combination thermometer and hydrometer, and one with a four-way reading hydrometer which indicates the gravity test of the gasoline.

Is Your Watch Accurate?

IF your watch is responsible for tardiness in meeting appointments or for missing a train, send it to the U. S. Bureau of Standards and have it tested. Any citizen of the United States has this privilege, the nominal charge being $1 50 for each watch, and errors are detected to the fineness of one-tenth of a second Within the past two years the Government has tested 25,000 timepieces for manufacturing concerns, individuals and Government bureaus

Watches owned by railroad men are usually the standard of accuracy in any community, but even these timepieces may fluctuate in keeping tab with the onward march of Father Time So the Bureau of Standards has undertaken a *new type of laboratory experiment*—the railroad precision watch test. The standard of accuracy is gaged by the average efficiency of new railroad watches, certificates being issued to excellent timekeepers The test extends over a period of 19 days, the watch be

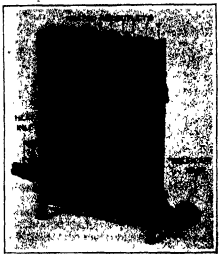
(*Continued on page 460*)

Precision clock used as standard for comparison in testing watches

A Forward Stride in Heating and Ventilation

IT has remained for Wm R Hildebrand of Chicago to develop a new ventilating radiator on which a patent has been granted This new radiator produces a constant air suction and air circulation by means of an adequate surface of contact whereby air is more rapidly and most efficiently heated Connected with the outside, this new radiator sucks in fresh air, heats it to an agreeable temperature, and distributes it freely throughout the room. It is thus adapted to take in fresh air continuously from out of doors and supplant the vitiated air of the living room, office or workshop without subjecting the occupants to cold draughts.

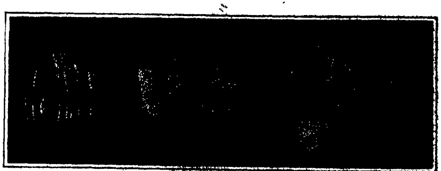
The construction is quite simple. There is an air inlet running parallel with the heat inlet and these two conduits carry and distribute heat and air.



A radiator that draws in fresh air and distributes heated air throughout room

Six Fuse Plugs In One

SPARE fuse plugs are seldom on hand when they are needed as renewals, following the blowing out of fuses from one cause or another. So users of electric current are often put to considerable inconvenience and delay for the simple reason that no spare fuses are kept in the fuse box. This human failing being quite common and seemingly incurable, inventors have of late been active in developing multiple fuse plugs, with the idea of making one fuse plug serve a number of times. One of these plugs is shown in the accompanying illustration, fully taken apart so as to show its three simple components One member is the plug proper, another is a porcelain piece with six grooves in which are placed six fuse wires, while the third is a brass cap through which projects the straight handle of the porcelain piece. The current passes through the button of the plug, through the fuse wire, and through the spring contact which connects with the outer screw shell of plug. By giving the handle a slight turn, the spring contact or finger engages with another fuse wire, so that the plug is good for six blow-outs, after which a new fuse-carrying member can be inserted in the same plug for six more occasions.



Components of a newly introduced fuse plug that is good for six blow-outs before renewal

Our Tropical Timber Trade

(*Continued from page 444*)

shuttles. The little that now dribbles into our market is by way of reshipments from England. There is also the East London and the Knysa boxwood from South Africa but they are not as good as the Turkish and are mostly consumed by the European shuttle trade. Nearly all the boxwood on our market is from Venezuela, though some comes from the West Indies. The logs are smooth and straight but only a few inches in diameter, and weighing from 150 to 250 pounds. In addition to rulers, some of this wood is "ebonized" for black piano keys in place of the too costly ebony. For our shuttles the flowering dogwood and the persimmon tree of our forests have proved satisfactory.

The trade in lignum-vitæ of the West Indies dates back 400 years to the early Spanish explorers, who thought they had in this material the panacea for all man's ills. The name, meaning the wood of life, is now all that remains to remind one of the wonderful curative powers ascribed to this wood when for upward of two centuries it was the fetish of the medical profession. Modern science has stripped aside the veil of credulity and revealed an unwitting fraud. Now lignum-vitæ plays a different rôle, this time a legitimate one. Here is a wood of extreme hardness and weight, with its fibers veritably woven together, and saturated throughout with an oily resin—the wood of all woods for machinery bearings. The propeller shaft of every steamship revolves in a lignum-vitæ bushing. It is the only wood known that combines the necessary strength, toughness, and natural lubricating property necessary for this exacting purpose. It serves also for mallets, casters, pulley sheaves, bowling balls, watch-makers' anvils, masthead trucks in wireless telegraphy and other uses.

From Brazil, particularly from Victoria and Bahia, comes the mildly fragrant and richly figured rosewood or jacaranda. Though familiar to the trade for a long time and one of Brazil's best known woods, yet even today botanists are not sure as to the species or even the genus of the trees which produce it. There are various kinds of the true and no end of impostors, but the American trade prefers the black variety, jacaranda caviuna, while the violet, jacaranda violetta, appeals more strongly to the English trade.

The rosewood business is organized poorly or not at all. The native farmer cuts a tree or two a year, chops off the bark and light colored sapwood, and drags the log to the nearest store to exchange for a handful of provisions. From the various storekeepers the slowly accumulating lots make their way in primitive fashion to some collecting place at a river boat-landing or railroad station. Here they are hewn off smooth with adzes, and the best grades for veneer are sawn in two through the middle and any rotten portions in the heart cleaned out. The logs are halved by pit sawing, that is, one sawyer stands on the log and the other stands in a pit beneath. Such primitive methods must be replaced by modern ones if the rosewood business is to retain its fast loosening hold on the trade. Its principal use in this country is no longer for furniture but for spirit levels. A limited amount goes into billiard tables, phonograph cabinets, and handles for butcher knives. All told we use about a thousand tons a year.

The Brazilian rosewood has some near relatives in Central America which fill some special places in our trade. The clear ringing tone of the Honduras rosewood makes that wood the first choice for xylophones. About a hundred tons a year are imported solely for this purpose. Another wood is the cocobola from the west coast of Central America and from Panama. Fifteen hundred tons of these logs are made into knife scales (sides of the handle), small turned articles, brush backs, and policemen's clubs. The logs are peculiarly mottled with various shades of red, yellow, purple and black and the colors are fast. Certain grades of this wood have an evil reputation among the workmen in our factories, as the dust is likely to cause a dermatitis, somewhat resembling ivy poisoning. The East Indian satinwood has a similar reputation, particularly among the workers in Glasgow.

The true satinwood comes from India and Ceylon and is used here in limited quantities for fancy brush backs, handles for toilet articles, and veneers for inlay in cabinet work. The West Indian satinwood comes here in small lots of small squared logs and finds its way to brush-back makers. That from San Domingo is considered better than the material from Porto Rico, Jamaica and the Bahamas.

Ebony is popularly supposed to be as black as night, but a lot of it isn't. The jet black kinds are the Gaboon, which is like hard charcoal, and the Madagascar, which is also called Nossi Be, Tamatave, and other names signifying the place of origin. These are used principally in the manufacture of musical instruments, *e.g.*, finger boards for violins and black keys for pianos, and for small handles of surgical instruments and fine silverware. The logs of Gaboon are small and may be only mere shells and fragments which have lain long in the woods; the Madagascar comes in the form of small, round, straight-grained sticks upward of 10 feet long. The scant supply and high price have led to the substitution of cheaper woods which are stained black or "ebonized."

The Madagascar and the Celebes ebony is mottled black and reddish brown, and comes in large sized logs. The wood is used in considerable quantity for brush backs, umbrella handles and to a small extent for policemen's clubs. The Camerun ebony is lighter in color and is little used except for small articles of turnery. The foregoing are true ebonies and are closely related to our persimmon tree. The ebony family is widely distributed throughout the tropics and there are over 200 species. The Camazon of the Philippines is a splendid and beautiful wood but like others of the group it is rare and hard to get.

The brown and the green ebonies are of a different family—the locust or pea family—to which so many of the hard and heavy and highly colored woods of the tropics belong. The brown ebony or coffee wood comes from Venezuela and Mexico where it is known locally as granadillo. It is extremely hard, heavy and tough and arrives in the form of logs mostly 12 to 14 inches in diameter and about 6 feet long. Those from Venezuela show from 1 to 3 inches of white sapwood but the Mexican logs are hewn to the heart. This is *the* umbrella handle wood. It is also employed in place of live oak for caulking mallets. The wood is called partridge in the English market. Green ebony or cocas from Cuba and Jamaica has always been the favorite for flutes and mouth pieces but it has become so scarce that the African blackwood has largely superseded it.

At one time there was considerable teak on our market but the best of it finally reached the prohibitive price of 80 cents a board foot (a board foot being a square foot of lumber an inch thick). Four kinds are recognized in the trade, namely, in order of preference, Burma, Siam, Cochin-China, and Java. Teak is imported in the form of flitches (sawn planks) 3½ to 6 inches thick, 6 to 14 inches wide, and from 6 to 30 feet long. Its principal use is in shipbuilding for railings, decking, steps, doors, etc. Formerly it was employed for backing for armor plate in battleships but concrete has taken its place there. Teak has the greatest reputation of any wood in the Far East.

The best known wood from British Guiana is greenheart, which belongs to the same family as our sassafras. This hard yellowish-green wood is noted for its lasting qualities in salt water and is very serviceable in wharf and dock construction. Large quantities went into the locks of the Panama Canal but very little is coming into our market. There is a fine opportunity for it in replacing the broken piling and rotten planking in New York's ferry slips. A hundred thousand billiard cue butts are turned out of this wood every year in this country. This industry makes use of every available tropical wood of the proper weight.

Makers of fishing rods make a special demand for tropical woods. They use some truee greenheart, some Surinam groenhart, some massaranduba or bullet wood, Macassar ebony, rosewood, Haytian red cedar (juniper), bamboo, degame and lancewood spars. Degame spars come from Cuba in the form of perfectly straight smooth sticks 6 to 12 inches through and 18 feet long. From 50 to 100 tons are consumed here annually. Lancewood spars are from Jamaica—small slender sticks 5 or 6 inches in diameter and 13 feet in length.

A wood which has been recently introduced into our market is the balsa, mostly from Central America. This is one of the lightest woods known, some grades being lighter than cork. After waterproofing with paraffine it makes an excellent substitute for cork for all kinds of floats, life preservers and rafts, surf boards, etc., as well as for purposes of insulation as in refrigerators. Plantations of these trees are being established on exhausted banana lands and they reach timber size in about three years. There is authentic record of one tree which increased in thickness at the rate of an inch a month for the eight months it was under observation.

Various dye and extract woods find a market here. The quebracho from Paraguay and Argentina is the source of large quantities of tannin extract. This is a specialized industry and the timber does not enter the general timber trade. The name quebracho means axe-breaker, in appropriate reference to the hardness of the wood. Chief among the dyewoods are logwood and fustic from Mexico, Hayti, Jamaica, San Domingo, Central America, and Colombia. Then there is the brasillette from Mexico and Central America and Braziiwood from the country named after it. The latter wood was used during the war but the yield of dye is too low and the cost too high under normal conditions. Selected straight-grained, fine-textured sticks of this wood are in demand for violin bows, being known to the makers as Pernambuco wood. An occasional bow is also made from the peculiarly mottled South American snakewood or letter wood but it is not as "lively" as the Pernambuco bow.

The list is not complete but it embraces the staples of the trade. New woods are making a sporadic bid for favor, but too often under cloak of some established name. In time our tropical timber trade will experience a great change, will no longer confine itself to the rare and fancy woods, but extend to the commonplace materials of construction. But that time is not yet at hand and before it arrives much pioneer work will need to be done and much opposition overcome.

The Burning Mines of the Hocking Valley

(*Continued from page 445*)

all during the former winter when, at times, the temperature was fourteen degrees below zero.

At New Straitsville are two brothers, now the proprietors of a general store, who are said to have lost a fortune in trying to reclaim a portion of the fire area. They purchased a large section of the land, entirely surrounded by fire but itself

(*Continued on page 457*)

Old Glory is now on the Seven Seas

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Queenstown, Boulogne and London
From New York

June 7 July 12—August 16 —September 20 —Old North State (159)
June 28 August 2 September 6—Panhandle State (159)

Bremen and Danzig
From New York

July 13 August 30—Hudson (159).
June 8 July 28—September 7—Susquehanna (159)
June 15—July 28—September 14—October 20 Potomac (159)

Naples and Genoa
From New York

June 30 August 13—September 24 —Pocahontas (159)
June 8—July 20 August 31—October 12—Princess Matoika (159)

Plymouth, Cherbourg and Bremen
From New York

June 22 July 28 August 24—September 28 America (159)
July 30—August 27—September 24—George Washington (159)

SOUTH AMERICA

Rio de Janeiro, Montevideo and Buenos Aires
From New York

Huron (91)
June 8 Aeolus (91)

FAR EAST

Honolulu, Yokohama, Kobe, Shanghai, Manila, Hongkong
From San Francisco

Golden State (105)
July 23 Empire State (105)

Yokohama, Kobe, Shanghai, Hongkong, Manila
From Seattle

June 18—August 27—Wenatchee (106)
July 9 Silver State (106)
July 30 —Keystone State (106)

HAWAII, PHILIPPINES, EAST INDIES

Honolulu, Manila, Saigon, Singapore, Colombo, Calcutta
From San Francisco

June 11—Wolverine State (105)
July 14—Granite State (105)

COASTWISE AND HAWAII

Havana, Canal, Los Angeles, San Francisco and Hawaiian Islands
From Baltimore

June 11— Buckeye State (80)

80 Matson Navigation Co
120 Market Street San Francisco, Cal
26 South Gay Street Baltimore, Md
91 Munson Steamship Line
67 Wall Street N Y
Tel Hanover 6120
105 Pacific Mail S. S Co.
10 Hanover Sq., N Y
Tel Bowling Green, 4630
621 Market Street, San Francisco, Cal.
106 The Admiral Line
17 State Street N Y
L C Smith Bldg., Seattle, Wash.
159 U S Mail S. S Co., Inc.
45 Broadway, N Y
Tel Rector 6300

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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

HAT LINING—B HOROWITZ, 552 Broadway, Brooklyn, N Y This invention has for an object the provision of construction wherein the lining of a hat may be stitched in by *machine and at the same time give the appearance* of a usual hand stitched lining A further *object is the provision* of a hat lining in which there is provided a substantially annular portion to be stitched in place and a central portion to be clamped in place

Electrical Devices

TELEPHONE COLLECTION BOX APPARATUS—O A PEDERSEN, 509 Willis Ave, Bronx, N Y Among the principal objects which this invention has in view are to secure prepayment for telephone services in multi branch installations, to provide a fee payment system for house telephones and to avoid interference in the use of the branches of said system

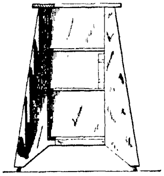
ELECTRICAL TRANSMITTING APPARATUS—H K HARRIS, 96 Victoria St, Westminster, London, England This invention relates to electrical transmitting apparatus of the hand set type, manipulated by hand or power for transmitting electrical impulses to an advertising or other device adapted to be set into position by such electrical impulses, and combined, if desired, with automatic means for reversing the direction of movement of the device

Of Interest to Farmers

VALVE FOR IRRIGATION PROJECTS—W J COLEBURN, Wilkins, S C The invention more particularly relates to a simple, effective valve structure for use in connection with tiles for transporting water in irrigation projects, the object being to provide an inexpensive arrangement *which may be readily associated*, in fact molded, in connection with irrigation tiles *at whatever points may* be desirable *for* the location of the valve boxes

Of General Interest

BOOKCASE AND MAGAZINE HOLDER—W C WILSON, Johnson City, Tenn The invention particularly relates to a combined device wherein the books and magazines as well as papers may each be supported with its title exposed and in readily accessible position, the object being the provision of a simple inexpensive device adaptable to either the home or public libraries, and capable of being made in a variety of materials to suit its surroundings



A FRONT ELEVATION PARTLY BROKEN AWAY

POWDER PUFF—W. G KENDALL, 118 Market St, Newark, N J Among the objects of the invention is to provide a powder puff which is simple and durable in construction and cheap to manufacture, the parts being quickly and accurately assembled without resorting to sewing or requiring highly skilled labor Another object is to firmly fasten the body parts of the powder puff material in stretched position without danger of the parts becoming detached

APPARATUS FOR TEACHING DANCING—S E FEIST, 1050 Broadway, Brooklyn, N Y The invention relates to a construction which will automatically cause a person to assume a proper position when dancing An object is to provide a form or dummy and supporting means therefor which will cause a student to go through the proper movements in dancing when using the form as a partner, the form causing the student to initiate all the moves and thereby experience the necessity of acting on his own initiative

COLLAPSIBLE TUBE HOLDER—J H GIBBS, 130 Valley Rd, West Orange, N J The object of this invention is to provide a holder which will act in the double capacity of a holder and means for collapsing the tube to any desired extent Another object is to provide a holder constructed in such manner as to be readily applied to a wall or other support at a point of ready access

CONCENTRATED COCOANUT MILK AND PROCESS OF MAKING SAME—W S COOKSON, Taiping, Perak Straits Settlements An object of this invention is to produce a vegetable food product similar in composition to a pure rice, natural cream which by dilution with water to form four to ten times its original volume, provides a product varying in richness from that of ordinary dairy cream down to that of ordinary dairy milk, and one which is suited to all uses to which dairy milk or cream are ordinarily put

COCOANUT FOOD PRODUCT—W S COOKSON, Taiping Perak, Straits Settlements. An object of this invention is to provide a cocoanut product which contains a relatively small amount of pure natural oil or fat, and which therefore is easily digested as compared with desiccated cocoanut containing a relatively greater amount of fat, by the weakening of the cell walls of the tissue of the endosperm or "white meat" of the cocoanut by roasting the same until it is crisp and dry

GROUSER—S M WADE, 4000 Broadway Ave, Oakland, Cal The invention has for its object to provide a device of the character specified, capable of attachment to a link of a tractor chain to increase the traction of the chain, wherein the grouser is easily attached and may be easily detached when desired

SIX STREAM DISTRIBUTING ATTACHMENT FOR SODA WATER DRAFT ARMS—C R RAGSDALE, 5703 Enright Ave, St Louis, Mo The invention relates to soda water fountains The general object is to provide an attachment to be applied to the draft arm in lieu of the usual hard rubber nozzle found thereon, and whereby to produce speedy service the attachment providing a plurality of distributing members preferably three, and set in triangular relation so as to permit of the operator filling either one, two or three glasses at a time

CRATE—C A STEWART, c/o Public School 51, Richmond Hill, L I, N Y Among the objects of the invention is to provide a crate for packing fruit A crate constructed according to the invention permits of a packing of grape baskets in a particularly compact manner whereby the crates are not subjected to rough handling as usual A further object is to construct the crate in such manner that it provides a handle which will at all times serve to prevent danger of the crate being placed wrong side up

Hardware and Tools

PIPE AND NUT WRENCH—C McCARTER, address McCarter & Evans, Decatur, Ill This invention particularly relates to a nut and *pipe wrench which has for its object to* provide a quick setting feature whereby the parts *may be quickly set to the desired size* Another object is to provide a wrench which embodies *means for locking the movable jaw in* any set position

ADJUSTABLE HAND REAMER—F P MILLER, c o McCroskey Reamer Co, Meadville, Pa *The object of the invention is to provide an* adjustable hand reamer arranged to insure *a proper and accurate guiding to the reamer* when reaming long bores with a view to produce a bore true throughout its length Another object is to securely hold the cutters in place on the head of the reamer

LOCK—R F McCARTHY, 35 Clarkson Ave, Brooklyn, N Y The *primary object of the* invention is to provide a mechanism which is capable of being attached to the knob spindle of an ordinary door latch in such a manner that the operation of the knob spindle is prevented until various mechanisms of the device have been set A *further object* is to so construct the mechanism that the combination may be changed from time to time at the will of the operator

SINE BAR—H S NODDINGS, 1052 State St, Springfield, Mass The invention relates to measuring instruments, its object is to provide a sine bar arranged for convenient use on metal working tools such as lathes, and to permit accurate testing of all kinds of work. Another object is that by the use of the sine bar chances of errors in setting machine tools for making accurate angles are reduced to a minimum, and the user is enabled to set the sine bar quickly as well as accurately

FISHING TOOL—J F McDOWELL, 2015 Laurel St, Shreveport, La The object of the invention is to provide a tool which may be inserted into the top of a pipe, well casing or drill stem, and which when once inserted cannot be withdrawn until released, the arrangement being such that the tool may move freely downwardly in the pipe but clamps the pipe when it is moved upwardly and will be held against accidental displacement

Heating and Lighting

COPRA COOKER—A BARBA, 26 Alhambra St, Manila, Philippine Islands The invention relates to a cooker which while capable of other uses, is more particularly intended for use in cooking copra, which is the dried kernel of the cocoanut, the cooking being preparatory to the extraction of the oil The general object is to provide a cooker in which cooking may be effected in the shortest possible time, and with a minimum handling of the material

CONDENSER—R E THOMPSON, Deming, N M The invention particularly relates to devices for maintaining vacuum for the exhaust of steam turbines or steam engines The primary object is the provision of a condenser which will to a large extent transfer its heat to air, directly or through the evaporation of water on the surfaces of said condenser exposed to air, and the provision of a condenser unit which will be self sustaining in use to maintain a considerable internal vacuum *without collapsing when exposed* at its exterior to atmospheric pressure

Machines and Mechanical Devices

COMBINED DRILL AND UNDERREAMER—W T S WARNER, Yuma, Arizona The primary object of the invention is to provide a well drilling structure which will enable the well to be drilled and under reamed to enlarge the hole for the well casing in one and the same operation Another advantage consists in enabling the hole to be drilled at any depth with but one size of casing throughout from top to bottom

INDICATOR—A F FERRAND, 375 Delevan St, c/o W Simon, New Brunswick, N J The invention relates particularly to an indicator which is used in connection with metal working machinery such as milling machines, boring machines and the like, to facilitate the lining up of the work with respect to a tool holding device, and to readily indicate during the lining up process the degree of eccentricity of the work with respect to the tool holder

ELEVATING AND UNLOADING DEVICE—I SIBRAVA, Wilson, Kan The object of the invention is to provide mechanism consisting of a barge or body for containing a load and a wheeled support having a superstructure within which the barge has vertically guided movement together with means controlled by the movement of the wheeled support for raising the barge, and wherein the barge may be tripped to permit it to take an inclined position to unload the contents thereof

SHEET DELIVERY FOR PRINTING MACHINE—C WINKLER, Berne Switzerland The object of the invention is to provide a device for taking printed sheets from impression cylinders of printing machines in which tapes take the sheet with the printed side up from said impression cylinder at the surface speed of the same and deliver the sheet at a decreased speed to a system of open cords or tapes moving at the same decreased speed and arranged to be alternately wound on and off a spindle

KNOTTER—A E CRANSTON, 639 Peyton Bldg, Spokane Wash This invention is particularly adapted for use in connection with binding machines, it relates to knotters of the revoluble type which are used for twisting the several ends of a loop of wire subsequent to the wrapping of a bundle of shingles, staves, or the like for securing the same together for shipment

SANDPAPER DRUM—W L BROWNE, 328 Alameda St, Vallejo, Cal The invention relates to sand papering machines such as are used for smoothing, polishing, shaping and grinding wood or other material One of the objects is to provide a drum upon which the sheet of sand paper may be securely and evenly clamped and easily and quickly adjusted to properly conform to the drum

Medical Devices

SANITARY CASE.—C A. GREENE, 152 W 45th St., New York, N. Y. Among the objects of this invention is to provide a case compactly and conveniently arranged to carry receptacles of various forms and sizes, so constructed that the various parts carried are *readily accessible*, such parts including an instrument case and contents, sterilizing apparatus, *and suitable bandage and cotton* receptacles The device may be used for any purpose, but *is particularly adapted for* chiropodists.

Pertaining to Recreation

TOY—A P. BERGGREEN, c/o Northern Pacific R. R. Co, St Paul, Minn The object of this invention is to provide a device which is adapted to project toy projectiles or missiles through the air for a relatively great distance and with a high degree of accuracy, and which is of sturdy and durable construction, reliable in action and easy and inexpensive to manufacture

Pertaining to Vehicles

PROCESS OF AND MOLD FOR REBUILDING TIRES—H G BALLOU, 787 S. Westlake Ave, Los Angeles, Cal. The primary object of the invention is to provide an apparatus by which a progressive process of treating, rebuilding and retreating old and used tire casing may be carried out A further object is to so construct a tire mold that in addition to a new tread being formed on the tire treated stock may be applied to the side walls of the tire

TRACTION MOTOR—G. YATES, 3215 Carnegie Ave, Cleveland, Ohio The invention relates particularly to the rotating armature type of traction motors An important object is to provide a traction motor in which the effective driving power will be transmitted directly to the car wheels, thereby eliminating the use of transmission gearing and increasing its efficiency Another object is to provide a motor which will be simple in construction and inexpensive to manufacture

STEERING WHEEL MOUNTING—E F DAVIS, 403 Hoffman St, Elmira, N Y This invention has for its object to provide a mounting for permitting the wheel to be held firmly in a plane perpendicular to the steering column or to be tilted forwardly into a plane parallel with the said column, where it will be out of the way while entering or leaving the motor car

MONOCYCLE VEHICLE—C. POMILIO, Rome, Italy The invention refers to a monocycle vehicle which is shaped as a large roller or hollow drum of great diameter and of a width sufficient to contain the driving plant and materials for the transportation of passengers and crew on open land destitute of roads, the same being protected against external attacks and provided also with means of offense when needed.

Designs

DESIGN FOR A POWDER CONTAINER OR SIMILAR RECEPTACLE—C. S HUMPHREY, c/o Manhattan Can Co, Bush Terminal Bldg, No 10, Brooklyn, N Y.

DESIGN FOR A HINGE—A. KOETTING, 423 Wythe Ave, Brooklyn, N Y

DESIGN FOR APPLIQUE TRIMMING FOR WEARING APPAREL OR ARTICLE OF SIMILAR NATURE—O E. MAUL, 90 Vista Place, Mount Vernon, N Y

DESIGN FOR A NETTED FABRIC—H T MENDELSOHN, 40 W 25th St., New York, N Y.

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The Burning Mines of the Hocking Valley

(*Continued from page 455*)

clear. They bought the land with the expectation of checking the flames and stripping the earth from the coal so that it could be mined cheaply and quickly Before they could begin operations fire appeared on their land All attempts to halt its progress have been futile. Brick walls were built across the mine tunnels with the hope of smothering the fire, but these apparently had no effect Double brick walls were then tried and after that a space was walled off and filled in with dirt. This latter scheme was partially successful and believing the fire was extinguished, preparations were made to strip the land, but before these were completed three new craters were blown out and the fire started with renewed energy By this time the firm's finances were exhausted and the project was given up as hopeless

The State of Ohio likewise has abandoned efforts to stop the fire after several ineffectual attempts In one of the earlier attempts water was pumped into one of the mines for three years continuously At the end of that time no impression had been made on the fire It is believed the intense heat turned the water into steam before it reached the coal, rendering it ineffectual Chemicals also were tried without success In some rare instances the fire has been stopped in spots, only to break out in others near by

This is really the principal difficulty of the situation If the fire were burning in a single direction or from one center, it might be stopped at an expense justified by the value of the coal to be saved But the fire has burned most readily along the outcroppings of the vein and as a result it is burning in hundreds of places scattered all over the territory

The fire is the cause of many freakish occurrences Not long ago an aged miner was looking at a section of sunken road and commented on the soundness of the ground he was standing on when it suddenly gave way He tumbled into what had been an old shaft and he was able to make his way out without injury

In the spring the vegetation on ground warmed by the fire to the proper temperature becomes green and the flowers bloom a month or more before the usual season Other areas are so hot that even in winter heat waves arise from them as though from a giant stove top Smoke issues from the most unexpected places In one spot smoke issued from a hollow tree although no other smoke appeared near by.

The most imposing sight, no doubt, is at "Smoke Valley" It is, as its name indicates, a wide valley which has all the appearance of a giant cauldron In places here the earth has been churned by upheavals and sinkings until it resembles a shell-torn battlefield. The simile applies as well to the whole region Certainly the battle areas of France present a picture of desolation little more striking than this

Weighing the Ten-Millionth of a Milligram

(*Continued from page 445*)

a millionth part of a milligram, the volume of the bulb and change in air pressure being known. Minute weights of pure quartz are used as well, the value of which has been ascertained by comparison with "air-weights." An alternative method consists of using "magnetic weights" in the place of air-weights; this involves the use of a measured electric current. The range of weighings depends on the size of the beam; with one 5 centimeters in length the maximum load is between 100 and 200 milligrams, and the setting can be made to within a ten-millionth part of a milligram.

The oscillations of the balance are read by optical means, a beam of light being reflected on a vertical scale from a minute mirror fixed to the beam of the balance The mechanism of the balance by which its beam is suspended from or lifted off the fibers is controlled by an electromagnetic arrangement, without any material connection through the walls of the balance case

Some important improvements, viz, an arrangement allowing the quartz fibers within a few minutes to be placed in position or detached and an attachment for varying the sensitiveness of the balance, are due to Dr Strömberg If a fiber should be accidentally broken a reserve fiber can be quickly inserted without removing the balance from its place, in fact, with the same ease as a string is replaced on a violin

A balance surpassing a hundred thousand times the sensitiveness of the ordinary chemical balance, of course, opens up practically unlimited possibilities of scientific research and is bound to become indispensable to physical and chemical laboratories Some highly interesting subjects have already been investigated by Dr. Petterson, viz the gradual loss of weight of a silica sphere in a vacuum at temperatures of 600 to 800° Cent, the changes in weight of a piece of gold subsequent to heating, and the magnetic properties of pure nitrogen and hydrogen gas It is now expected to investigate the pressure of light, the measurement of absolute temperature, and the loss of mass accompanying loss of energy

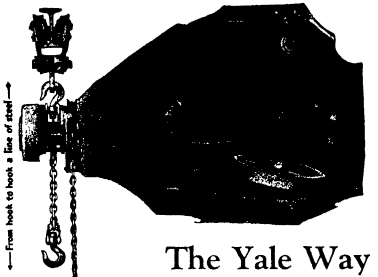
Revolutionizing an Industry

(*Continued from page 446*)

Wisconsin has found that community cooperation is fundamentally essential for the practical and profitable production of hemp Machinery for harvesting the crop is expensive and usually must be owned in partnership by a number of neighbors The mills for separating the hemp from the woody stems cost anywhere from $10,000 to $50,000, depending on their capacity and equipment and must be necessarily located in sections where hemp growing is a permanent business It is essential that from 500 to 750 acres of hemp be produced annually to keep each of these mills busy This involves the concentration of production around definite milling centers so that sufficient raw material is assured to make the operation of the mills profitable

To a certain extent hemp is a crop which prospers only under proper conditions of soil and climate It is not adapted for universal culture in all parts of this country but it provides propitious opportunities for successful production in territories where the local environments are favorable for its growth It prospers in the humid sections of the temperate zones, although some of the birdseed varieties mature in from two to three months in northern Russia For seed production, hemp demands a growing season of six months or longer while for fiber production it will mature in four months Hemp has been produced successfully in the United States only in sections where the annual rainfall amounts to at least 30 inches Wisconsin's climate is excellent for hemp growing as the autumn months are cool and moist, conditions which promote the efficient seasoning and retting of the fiber

It is essential to harvest fiber hemp at the right stage of maturity or else deterioration will result Under Wisconsin conditions, hemp harvest season occurs between September 10th and October 1st Practically all the foreign supplies of hemp are still harvested by hand and it has only been since 1917 that an efficient mechanical harvester has been perfected and extensively used in this country. It cuts the hemp and spreads the stalks in even swaths, performing this work much better than it can be done by hand. The American hemp crop is produced by dew-retting systems, that is, exposing the hemp to rains, dews, frosts and sunshine



The Yale Way

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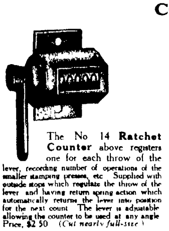
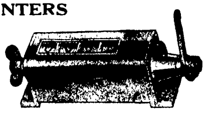


The No 14 **Ratchet Counter** above registers one for each throw of the lever, recording number of operations of the smaller stamping presses, etc Supplied with outside stops which regulate the throw of the lever and having return spring action which automatically returns the lever into position for the next count The lever is adjustable allowing the counter to be used at any angle Price, $2 50 (*Cut nearly full-size*)



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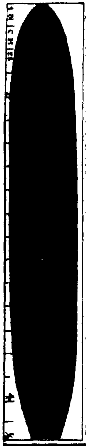

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spread out on the field which produced the crop. This effects partial decomposition so that the inner bark is loosened from the wood and the fiber can be more easily separated from the stalks. Usually it takes from four to ten weeks to dew ret the hemp where the weather conditions are favorable. It is of maximum importance that the hemp be properly retted before being removed from the field and only the experienced grower knows exactly when this condition is reached.

Subsequently, the hemp stalks are gathered and bound in bundles which then are shocked up like corn. All this work was done by hand until 1918 when a gather-binder was invented which collects the stalks from the swath and binds them together. In regions where central breaking mills are operated, the bundles of hemp are delivered to the mill as soon as possible after shocking where the stalks are broken immediately. Where some time must elapse before the hemp can be transported to the mill, the practice is to stack the bundles so that the crop will pass through a sweat like small grain. Experience in building stacks is necessary as where the crop is not properly stacked and the bundles are needlessly exposed to weathering, heavy losses of fiber will result.

It is necessary that hemp be wholly dry when broken and the profits from the crop often hinge on the success of this activity. Formerly, the custom was to have portable machines which journeyed itinerant-fashion from farm to farm to perform this work but weather uncertainties always markedly limited such operations so that the modern plan is to kiln-dry the stalks at the mill before they are broken. The traditional practice up to the last few years was to break the crop—crushing the wood underneath the layers of fiber so as to favor the easy separation of these two materials—with a hand brake which was a tedious, costly and strength-racking practice. The average, experienced worker could only break from 100 to 200 pounds of cleaned hemp daily by hand. Industrial science has been responsible for the making and successful operation during recent years of power brakes which accomplish the work mechanically by means of fluted rollers, and thus work more efficiently and more cheaply than hand labor. The modern hemp mill consists of a receiving room, dry kilns, breaking room with brakes, scutchers and balers, boiler room, engine and fan room.

In the dry kiln the excess moisture in the hemp stalks is removed by the use of a hot-air blast. The dry stalks are then fed into the breaking rolls where they are crushed and thence pass over a series of shakers where the loose hurds or woody portions are separated from the fiber. Then the fiber passes through scutching wheels which remove the remnant hurds. The fiber which is then fairly cleaned is baled and sold to cordage and spinning mills. Formerly, the scutching was done by hand, the uncleaned fiber being whipped over the hand brake until it was free from hurds. The present scutching machinery consists of from 2 to 4 large cylinders equipped on the exterior with wooden slats. The cylinders are stationary and revolve toward each other. As the fiber passes between the scutching cylinders, the hurds are all combed off.

The average hemp crop in Wisconsin yields from 1,000 to 1,200 pounds of fiber an acre, being higher than the production in Kentucky and only excelled by that of California. The fiber consists of long fibers, called line, which are worth about three times as much as the shorter fibers, called tow, the total fiber supply usually containing between 10 and 20 per cent of tow. One thousand pounds of rough fiber will produce about 850 pounds of line and 150 pounds of tow. Usually the average well retted and dried crop of stalks amounts to three tons to the acre which will yield 20 per cent by weight of rough fiber. Green hemp stalks contain about 60 per cent more water than when they are thoroughly retted and dried and hence a yield of three tons of retted stalk means an initial production of 7½ tons of green material. A first class crop of hemp usually brings in a gross return of from $75 to $100 an acre while the cost of production is only about $10 or $11 more per acre than it is for a crop of small grain such as wheat. The profits from the hemp crop are large and dependable, and indications are that the industry will be materially extended in the near future.

Before hemp or fiber can be spun into yarn, it must be either carded or hackled—submitted to combing processes by power machinery at the spinning mills. These operations remove foreign materials and reduce the fiber to finer, uniform strands. In the past, much of the Kentucky crop was hackled by hand and even today this costly method is still followed in some southern mills. However, the potential tendencies of the hemp growing and milling industry will be to make more extensive use of modern machinery which performs cheap and efficient work.

As matters stand at present, the hemp industry needs more certain sources of cheap and satisfactory seed. Kentucky bottomlands have supplied much of the seed crops used up to this time but the prices demanded for Kentucky seed are exorbitant and new sources of seed are now being developed. In some sections, a standard market classification of the locally grown fiber is prerequisite potentially if the industry is to expand without trouble. The growers must exert every effort to produce the best quality hemp while the millers must specialize in their abilities to distinguish between the different grades of hemp and so to handle the material that it will, subsequently, be in the best possible condition for further processing in the spinning and cordage mills.

Is the Practical Helicopter in Sight?

(Continued from page 447)

like an elevator, so to speak, several men being in a circular metal chamber or cabin on top of the helicopter.

Briefly, the Petroczy helicopter consists of a triangular frame which carries three 120-horsepower LeRhone engines. The engines drive two co-axially mounted air screws measuring some 20 feet in diameter, in opposite directions by means of the gear drive. These screws turn at 600 revolutions per minute. Above the engines and screws is mounted a metal turret or cabin for the crew, while below the power plant are the shock-absorbers for landing.

In a recent test of the Petroczy machine the crew entered the top turret. The motors were set going at full speed. The big screws whirled round. Then, held captive by the restraining cables, which were paid out gradually, the machine rose straight up into the air till it was at a height as great as 160 feet. Here it remained stationary, providing, as the inventor claims, an ideal machine for observation work in connection with artillery fire.

The Petroczy machine is hauled down by the cables when the flight is to be terminated. No attempt has as yet been made to throttle down the engines in order that the helicopter may sink down of its own accord, because there are certain problems of stability yet to be solved. In fact, it is reported that during a recent flight the engines ceased to function properly and the machine began to oscillate, threatening to side-slip. The crew made use of the parachute, always carried in the cabin, and succeeded in reducing the rate of descent so that a safe landing was effected.

It is understood that Louis Brennan of England has developed a helicopter very much along the same lines as Lieut.

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Petrocsy, which is to be tested shortly. It is said to represent a marked improvement over the Austrian machine.

Another recent machine is the Peugeot-Oehmichen helicopter, which makes use of a gas bag for part of the lifting force This machine employs two special screws 20 feet in diameter, driven by a 20-25-horsepower engine. The hydrogen gas bag, mounted at the top of the machine, has a lifting effect of about 170 pounds, or about one-fifth of the total weight of the machine with the pilot. In recent tests at Valentigney, France, this machine made free flights at six or seven feet altitude, as shown in the accompanying illustration.

The problem of helicopter flight is far from solved, for once the machine is developed that can rise vertically, it will be necessary to propel it in any direction The two methods generally proposed for propelling are to manipulate the helicopter screws in such a manner as to upset the normal equilibrium and therefore obtain a forward movement, and to use an additional screw or group of screws for purely propulsive purposes The Pescara, Berliner and other well-known types simply tilt the column that carries the horizontal crews, obtaining, so they claim, a forward movement

Another interesting type of helicopter is the Damblanc-Lacoin "Alerion," of French design and construction. This machine makes use of two huge lifting members, each consisting of four blades of about the same general shape as the usual electric fan, but built of wooden frame work with a fabric covering Two rotary engines coupled together drive the screws or lifting members The body of the "Alerion" follows the usual lines of the airplane fuselage; indeed, the idea behind this construction, with its elevator and rudder at the end of the fuselage, is to obtain some of the volplaning possibilities of the usual airplane in case of engine failure. The alteration of the lifting members causes horizontal motion This machine is but one of many of the same general class in which the helicopter principle is made part of the usual airplane construction.

The fact remains, despite the several interesting attempts now being made, that little has been done in the way of insuring helicopter flight in the near future, The successful helicopter remains to be developed, and once it is developed, there must be a repetition to a greater or less extent of the spectacular though costly days of pioneer aviation Intrepid pilots will have to risk their lives to master the new machines and to learn how to operate them, and it is doubtful if very much of their airplane experience will prove of more than general value

A Study in Magnitude

(*Continued from page 451*)

give ample room for sixteen automobiles and motor trucks to pass, abreast, across the bridge, if a rush of traffic made this necessary. On the lower deck will be ten railway tracks over which will pass the transcontinental trains of all the railroads that come into Jersey City from the west, and also such freight trains as are destined for Manhattan, the Bronx and Long Island.

A Weather-proof Bridge

A new and highly important feature introduced for the first time in a bridge of this great magnitude is that practically the whole of the Hudson River Bridge will be weather*proof*. That is to say, its steelwork will be so completely enclosed with rain-and-moisture-excluding material that the annual cost of repainting—a most serious item in the upkeep of a big bridge—will be reduced to a minimum. We have seen that the towers and cables will be so protected. The upper deck of the bridge being watertight, it follows that the whole of the steelwork below it, including the floorbeams, girders, tracks, et cetera, will be similarly protected. Each chain cable, as above stated, will be enclosed in a continuous watertight tube or casing of bronze which will enable the bridge crew to make periodical inspection of the eyebars which compose the cables The result of this weatherproofing is that only 15 per cent of the steelwork will be exposed Were it not for this protective feature, the annual bill for painting the scores of acres of surface of the bridge would amount to at least $500,000 Because of the weatherproofing the annual cost for painting will be but a fraction of this sum.

A Comparison of Weights

As may well be imagined, the weight of the steel in a bridge of these proportions runs up to a very high figure, and in the drawing at the bottom of the page an attempt is made to bring home this fact by comparing the bridge with three of the huge transatlantic liners which are themselves so impressive as to their length, height and bulk We find on drawing the ships to exact scale that the "Olympic," the "Leviathan" and "Aquitania" could be placed on the floor of the main span and still leave some 400 feet to spare Still more remarkable is the fact that the combined weight of these three vessels, when loaded, which is about 160,000 tons, would fall far short of the unloaded weight of the main span of the bridge

The Heavens in June, 1921

(*Continued from page 452*)

of radioactivity indicate that the crust of *the earth is at least one billion years* old—and probably twice that—and less than eight billion years old If then we may say in round numbers that this world of ours is three or four billion years old, our estimate seems unlikely to be twice too great, or twice too small

Two things should however, expressly be said First, these estimates depend upon the assumption that the forces known to science (at present) are at work, and no others We can obviously do nothing better than this, but future discoveries may upset this argument completely, as they did Lord Kelvin's Second, we are setting a limit only to the age of the *earth's crust* If as many astronomers think, the planets were formed at some remote period by some huge eruption from the sun, occasioned by the passage of another star close to it, the date we are attempting to fix may be identified with that of this giant catastrophe What happened to the matter which was later to compose the earth, while it was still a part of the sun, he would indeed be a bold man who would define There may be still heavier atoms in the sun, which break down and form uranium Or perhaps it may be that under the enormous temperatures and pressures that prevail in the sun's interior, energy is put into atoms in some way, and heavy ones like uranium are built up We pass here beyond the present limits of our knowledge, and it would not be safe to extend chains of similar reasoning further in the attempt to set an age for the sun As for the age of the universe as a whole—if our little planet is so old, what limits, even in imagination, dare we set for the life of the vast galaxy in which it, and all our system, is but a speck?

The Heavens

The finest part of the sky is now in the south On the meridian we find Scorpio, the great red star Antares (probably a rival of Betelguese in real size) blazing at the creature's heart, and the long line of the tail sweeping down to the horizon and curving back to form the sting To the left is Sagittarius, with the little Milk Dipper Above this is a magnificent region of the Milky Way, full of bright star clouds, clusters, nebulæ, and all sorts of interesting objects. One cloud, about midway between Gamma Sagittarius and Lambda Scorpii, fairly rivals the famous cluster in Perseus.

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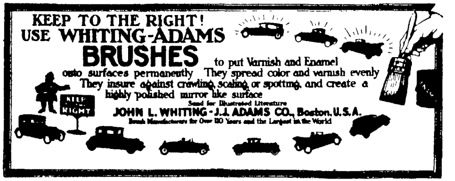

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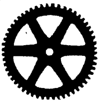

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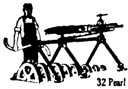

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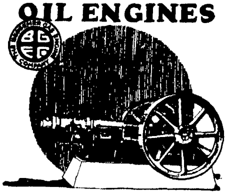

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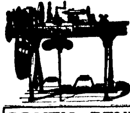

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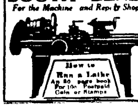
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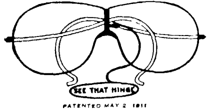

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Following the great arch of the Milky Way up to the eastward, we come upon Aquila and then Cygnus, with Lyra above, then passing the duller region of Cepheus we reach Cassiopeia low in the north Draco and Ursa Minor are above the pole, and Ursa Major is descending in the northwest Leo is sinking in the west, carrying Jupiter and Saturn with him Virgo is well up in the southwest and Bootes higher Hercules and Corona *are overhead, with Ophiuchus and* Serpens filling the space beneath them

The Planets

Mercury is an evening star this month, and is very favorably placed, especially *about the time of elongation on the 11th* He is then 24 degrees east of the sun and the same distance north of the celestial equator so that he remains above the horizon until 9 12 P M (This hour, like all others in the present summary is standard time, and not the daylight saving variety) He is then in the middle of Gemini and appears as a star of the first magnitude, exceeding both Castor and Pollux

Venus is now a morning star drawing steadily away from the sun, and is very bright At the beginning of the month she *rises at 2 40 A M,* while at its end she comes into sight at 2 o'clock Telescopically she appears as a wide crescent, while she is readily visible to the naked eye in broad daylight, if only the observer has something to guide his vision to her

Mars is in conjunction with the sun on the 29th, and is invisible all this month—and next month too

Jupiter and Saturn are close together in Leo, about 8 degrees apart at the beginning of the month, and 6 degrees at the end They are past quadrature and set *about half an hour after midnight on the* 1st and about 10 30 P M on the 30th Saturn's rings are turned so that we see their dark side all this month, hence they will be invisible in small telescopes, while in giant ones the 'condensations' may be seen which mark the places where sunlight filters feebly through the interstices between the particles which compose the ring

Uranus is in Aquarius and comes to the *meridian at 5 A M* in the middle of the month Neptune is in Cancer and is an evening star setting at about 9 P M

The *moon* is new at 1 A M on the 6th, in her first quarter at 4 P M on the 12th, full at 5 A M on the 20th and in her last quarter at 8 A M on the 28th She is nearest the earth on the 8th, and farthest away on the 23rd During the month she comes into conjunction with Venus on the morning of the 3rd, Mars on the 6th Mercury on the 7th, Neptune on the 9th, Jupiter and Saturn on the 12th, and Uranus on the 26th The *conjunction with Venus is fairly close,* but occurs before the planet has risen in our longitude

The Canal Lock

(*Continued from page 453*)

rection 90 degrees apart The bars are provided with beveled stops, known as 'dogs," designed to engage one another When these dogs meet it is impossible to move one bar until the turning of a control handle has lifted the dog out of the way Other control handles meanwhile are locked out of action The advantage of this arrangement is that there is no possibility of an incorrect sequence of control No handle can be turned out of *its proper order, so that the operator* cannot move handle No 4 before he turns handle No 3 a proceeding which might empty the water out of a lock while the vessel was still in the lock chamber —By *Ralph Howard*

The Earth-Boring Machine

(*Continued from page 453*)

mechanically or by gravity An improvement on augers heretofore used is an earth retaining gate developed by the above officials *The difficulty experienced* with the standard type of auger was that a considerable amount of earth would fall from it when raised from the hole.

The speed at which the auger is fed is, of course, dependent upon the nature of the soil A hole six feet deep, twenty-two inches in diameter, can be bored on an average of seven minutes, considering all classes of soil For hard pan, the auger must be turned slowly to prevent the cut*ting edges of the auger from being burned* It may be said here that the cutting edges are replaceable, which fact lengthens the life of the auger These cutting edges, two in number, are placed at an angle such as is found in a standard twist drill.

The Surveying Searchlight

(*Continued from page 453*)

establishing accurate geographical positions Certain points conveniently distributed over the United States are located astronomically with exactness, and from these points are determined other positions, for instance in the survey of a city lot or farm Geographical positions are determined by the triangulation method, that is, three points which are accessible and visible from each other are selected to form the corners of a triangle The angles of the latter, frequently extending from 10 to 100 miles in order to be *measured have their corners rendered* visible to the observer

Sunlight is an ally when a mirror reflects the rays, in surveying Not all days are favored with sunshine, fog and smoke frequently interrupting the operations of Uncle Sam's surveyors Night observations are likewise sometimes to be desired Hence the purposes of the signal lamp, which in addition to reflecting an intense light, is portable, a factor to be appreciated when surveyors *travel afoot* and convey their burdens in pack horse fashion The new lamp functions when connected with a battery of three dry cells, whereas its predecessor fed from a series of six and consumed power somewhat extravagantly

The inventor, in designing the light-reflecting outfit, recognized the principle that the filament should be concentrated within the smallest possible radius in order to, when placed in exact focus with the parabolic reflector, produce a beam of light as nearly parallel as possible A *tiny filament was deemed sufficient to supply* light at a distant point the bulb being so small that a current of six-tenths of an ampere is adequate to yield an apparent beam candlepower of 17,500 at a distance of 100 feet The current consumption is approximately two watts

Is Your Watch Accurate?

(*Continued from page 454*)

ing under laboratory observations for rate in five positions and at three temperatures

The rate of any watch is largely influenced by two factors, the position in which the timepiece is running and the temperature The Bureau of Standards railroad precision watch test particularly emphasizes adjustment for satisfactory *running in different positions* During the 19 day test the rate of the timepiece is determined in five positions and three temperatures The performance of the watch is determined according to three criterions, two of which apply to position, and one each to temperature, recovery (repeatability), and regulation

The minimum requirement of the Government test is about on an equal to the average new railroad watch If the performance of the timepiece meets the requirements, the Bureau of Standards grants a certificate A number of manu*facturers* keep constantly on hand a supply of these timepieces certified by the Government. Such certificated watches may be obtained for slight additional cost and are suitable timekeepers for those desiring accurate timepieces.

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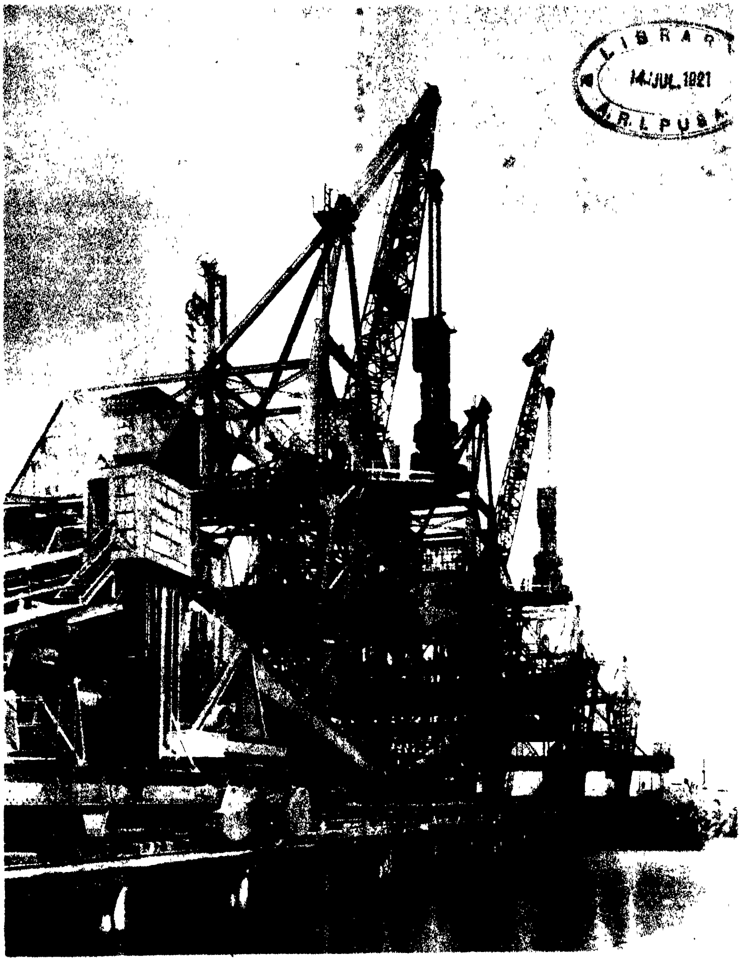

NEW COAL PIER AT CURTIS BAY, BALTIMORE, WHICH HANDLES SIXTY TONS PER MINUTE —[See page 470]

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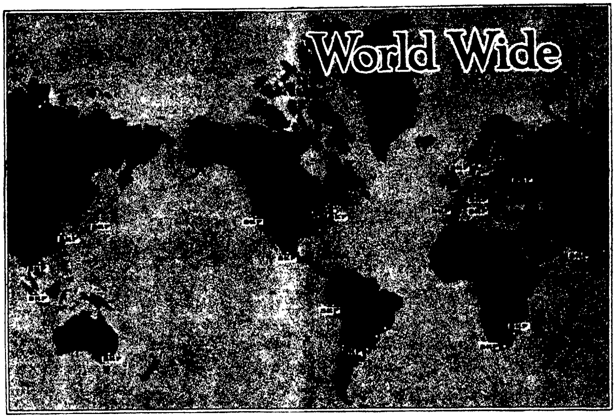

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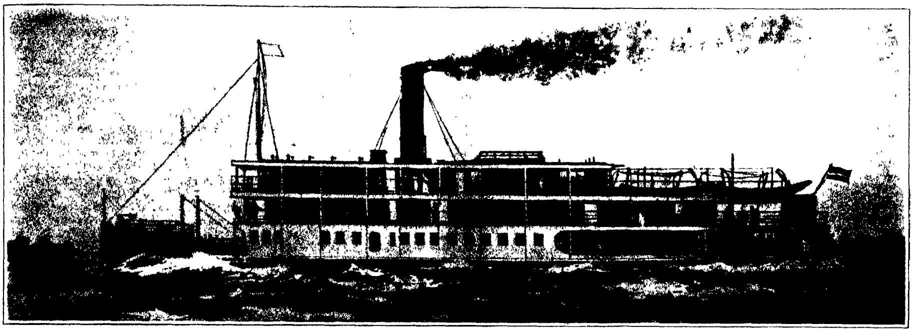

Shallow-draft steamer "Anning," built for use on the upper Yangtse-Kiang River. Length, 190 ft., beam, 30 ft.; depth, 8 ft , draft, with 260 tons, 5 ft Speed, 15 miles per hour

The Yangtse Shallow-Draft Steamer "Anning"

THE *Yangtse Kiang in addition to being one of the* longest rivers in the world is remarkable in being the only artery connecting the province of Szechuan with the outer world, except for foot trails which in places pass through difficult country and over high *mountains The province of Szechuan, known in Chinese* history as "Nature's Treasure House, has an estimated population of about 60 to 70 million people, so that the provision of an adequate steamship service on this river is of very great importance

On the lower reaches ordinary steamers of considerable size can navigate as far as Ichang, a distance of about 1,100 miles from the mouth Above Ichang, however, the conditions are considerably changed, the river between that town and Chungking passing through rugged mountain defiles, where the depth of water ranges from 6 to 60 fathoms at the low level of winter

The rapids, whirlpools, "boils," "freshets" and other phenomena peculiar to this river, combined with local fogs and shifting shoals, render navigation more difficult than in almost any other part of the world, and call for a vessel having shallow draft propelling machinery of abnormally high power, good steering capabilities, reliability and special arrangements for warping or hauling over a rapid

In 1913 the "Shu-Hun' was constructed by Messrs Yarrow & Co. for the Szechuan Steam Navigation Company to ply between Ichang and Chungking The great success of this vessel has resulted in the ordering of a number of vessels of the same type One of these, the 'Anning, has recently been completed by the same firm and shipped in pieces A short description of this vessel will be of interest

The 'Anning' is an almost exact repeat of the 'Shu hun' but embodies several improvements which have been introduced since that vessel was built Her length overall is 190 feet, beam 30 feet and the depth molded to main deck 8 feet The hull is divided into nineteen compartments by transverse and longitudinal bulkheads, and watertight doors are fitted to the bunker bulkheads There are four decks the main deck, upper deck, boat deck and awning deck

The accommodation for European and first-class Chinese passengers is on the boat deck On the upper deck are accommodated the officers and second class Chinese passengers

On the main deck there is accommodation for 206 Chinese steerage passengers, 15 firemen and 3 Chinese engineers and in the forecastle there is accommodation for 4 petty officers and 12 men and there is also a mess place for 14 cooks and boys

The vessel is lighted throughout by electric light There are 5 separate holds for cargo having a total capacity of 16,000 cubic feet, which corresponds with a deadweight capacity of about 260 tons at 5 feet draft

There is a special double-headed steam capstan forward, one head being arranged for working the anchors and for ordinary warping purposes, the other being specially designed for warping up the rapids at such times as these may be too strong for the steamer to navigate under her own power Large rollers are fitted on the berthing for bringing in the warp Strong bollards and fairleads are arranged both forward and aft

The main propelling machinery consists of two sets of triple expansion surface condensing engines capable of developing about 2,000 indicated horsepower The boilers are two in number of the company's double ended water tube type

The propellers are of large diameter suitably designed for transmitting the large power which the engines develop They work in tunnels fitted at the after end with the Yarrow automatic flap, whose operation is as follows

Referring to the line drawings, in Fig 1 is shown the ordinary screw tunnel vessel By means of the tunnel a larger propeller can be fitted than the draft of water admits, an obvious advantage where the draft of a vessel is limited When the boat is at rest the upper part of the tunnel above the water line is filled with air, immediately the propeller commences to revolve the air is driven out of the tunnel and replaced by water so that the propeller works efficiently on a solid column of water It will be seen that if the draft of the vessel is increased by loading more heavily, the fixed sloping part of the tunnel shown in Fig 1 would extend at the after end considerably below the water line and act as a drag, reducing the efficiency of propulsion The details of the new system are shown in Fig 2 the after end of the tunnel being sealed by

(*Continued on page 477*)

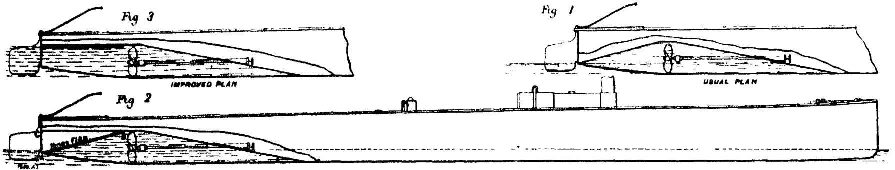

Fig. 1. Old style of tunnel. Figs. 2 and 3, new style with hinged flap, which adjusts itself to the draft of the vessel

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Aerial Radio Protection

IF the shocking airplane disaster near Morgantown Maryland, on Decoration Day results in the establishment of a governmental radio service for the protection of fliers throughout the country, the seven victims of the disaster will not have died in vain In all probability the fatal crash is to be attributed not to the pilot or to the machine, but to the weather The pilot was an experienced and able man, the machine was very stable—a point on which the writer is entitled to speak, having made a trip in the "Eagle" during which his most predominant impression was of its great stability Furthermore, the fact that the machine was to carry some distinguished passengers renders it certain that, for this trip it had been thoroughly overhauled and inspected by Army mechanics At the present writing it seems fairly certain that the pilot, because of the thunderstorm, was making a landing when he was caught in some down rushing body of air that dashed the machine, nose first, to the ground while it was one or two hundred feet above the earth Had the machine been 1,000 or 1,500 feet up, it would have been possible for the pilot, even in those disturbed conditions, to have righted the machine and flown it out of the area covered by the electrical storm

It has been suggested that the machine was caught on the forward crest of what might be called a wave billow or breaker, and borne to earth just as a fisherman's skiff is thrown down and crashed upon the beach by a breaking billow in a great sea storm This is altogether possible Something of this effect may be seen occasionally, in an advancing electrical storm cloud, when the black masses of vapor curl over and are hurled violently downward, very much in the fashion of a big wave breaking above a bar or upon a sloping shore Under such conditions the elevators and ailerons are rendered impotent, and, should the machine be flying with the storm she would be caught and rolled over, nose first in the fashion described by a man who witnessed the recent disaster

The obvious moral of this tragedy is that aircraft, big or little, should never go up when storms are locally imminent, or traverse aerial routes on which the atmospheric conditions are threatening Obviously the only way to obtain such security is to provide for the wide and hourly dissemination to air stations throughout the country of full meteorological data

The National Advisory Committee for Aeronautics has recommended the establishment of a bureau of aeronautics in the Department of Commerce Whatever division of opinion there may be as to the reorganization of the Army and Navy into one united Air Service, there can be no two opinions as to the advisability of forming a Government Bureau of this or similar character, whose duty it shall be to furnish all aviators and all the landing grounds with full information as to meteorological conditions that affect aerial travel This data could be dispatched by radio or telephone This movement should secure unanimous and speedy action on the part of Congress

War by Annihilation

"MR CHAIRMAN the Chemical Warfare Service has discovered a liquid approximately three drops of which when applied to any part of the skin, will cause a man's death Much smaller amounts than this or even vapors from the liquid, cause very severe, slow healing burns"

If the reader applies to the Government Printing Office at Washington, he can get therefrom a copy of the Hearings at the Third Session of the House Naval Affairs Committee, and he will find there that the words above quoted form part of a statement by Mr Bradner, Chief of Research of the Chemical Warfare Service Mr Bradner goes on to remind the Committee that the World War showed it to be possible for an airplane to fly within a hundred feet of enemy troops and machine-gun them with immunity, and he goes on to state that if, instead of carrying machine guns, the attacking planes were equipped to carry a tank of this liquid (Lewisite) for discharge from nozzles similar to the ordinary street sprinkler, it would fall like rain killing everything in its path

Then he becomes more specific and tells us that one plane, carrying two tons of the liquid, could cover a stretch of country 100 feet wide by seven miles long in one trip, and that it could spray down enough of the liquid gas to kill every man in that area simply by the action of the gas upon the skin Then, a little later, he becomes even more specific and tells us that, during the Argonne offensive, the entire First American Army of a million and a quarter men occupied an area of approximately 40 kilometers long by 20 kilometers wide If he goes on to say, Germany had possessed 4 000 tons of this material and, say, 350 planes properly equipped for spraying, our entire First Army would have been annihilated in from ten to twelve hours

Now 4,000 tons seems like a big lot of gas, but we already possess at the Aberdeen Proving Ground a huge poison-gas factory (Edgewood) which was capable, at the armistice, of producing 200 tons of gas per day, and it would be a simple matter by enlargement and duplication to put this country in a position where it could produce several thousand tons of gas for the supply of our armies, and keep the supply going indefinitely Yes, the future war will be so horrible as to make the late war restful by comparison Short as it will inevitably be, it will last long enough to wipe out mankind at a rate which will turn many a flourishing capital into a deserted village, and many a fair campagna into a Sahara of lifeless desolation—for this gas, remember, is as fatal to vegetation as to human life

All this talk, however, about the poison-gas war of the future is based on what we dare to believe is an altogether unwarrantable assumption, namely, that the devil's own disregard of the humanitarian laws of war initiated by the Germans at Ypres, is to be accepted and practised by the world at large If, in the forthcoming meetings on disarmament, or of the suggested "Association of Nations," or the League or what not, it be accepted that poison gas warfare is lawful, we dare to believe that this sanction will be given in the face of the protest of that undoubtedly large majority of men, who believe that honor chivalry and human kindness are not quite dead in our midst, and that the monstrous horror of the first gas attack at Ypres should not be the yardstick by which we measure our future military conduct

It has been urged that the free use of gas will make future wars so frightful that no nation will dare to provoke a conflict The answer to that assumption is that, in the past, the development of new weapons of great destructive power has never prevented a nation from rushing into war

The Price of Fame

AMERICAN enterprise has always been a source of pride to Americans, and nowhere is it better exemplified than in American newspaperdom The lengths to which the gatherers of the daily news will go to secure or to avoid a "beat" are proverbial If these methods were applied with discrimination, all would be well, but they are not applied with discrimination The same general rough and ready procedure is employed in getting inside the police lines to cover a big fire or a big crime, and in seeking an interview with the celebrity of the current hour When this celebrity happens to be a principal in a sensational case, this is all very well But there are those who are in the public eye in a different capacity, who ought to have some rights in the presence of the reporter and the camera man yet to whom such rights are ruthlessly denied

A case in point is that of Mme. Curie Her visit to America to receive her gift of radium might have been an unalloyed pleasure and a much-needed holiday Instead of this it has been made, largely through the efforts of the American press, a continuous nightmare. A distinguished guest must expect to be met on arrival in America by a delegation of newspaper men, and may be supposed to have prepared for this meeting A coming-off party at the dock, prefaced by such preparation, would be to any reasonable visitor a pleasure rather than a pain But the visitor will learn, before he has been twenty-four hours on our soil, that this is but a taste of what is to come. He will find his hotel crowded at all hours, day and night, with picture-takers and interview-seekers who never sleep—or who are replaced by others as fast as they succumb to fatigue Go where he will, do what he can, he is dogged by these pests, for whom the most emphatic "No" is merely the signal for renewed attack

The program mapped out for the discoverer of radium was itself a severe one, involving much traveling about in a hurry, much public appearance, much formal entertainment. This was part of the program. But we have no doubt that the good lady supposed that after her first reception on landing, the demands of our press would be satisfied by her appearances in public, with an occasional prepared statement for the entire press Instead of this, she is literally besieged in every stopping place by an army of special writers who want pictures, pictures, pictures, and interviews, interviews, interviews, on every subject under the sun—those on which Mme Curie is no authority as well as those on which she is This, be it understood, is "human interest stuff" And it goes without saying that every applicant must have nothing less than a special, exclusive and personal encounter with the great lady, with full permission to ask any question and any number of questions desired. The result of this is, with not the slightest exaggeration, that Mme Curie has been hounded to an extent that has imperilled her health, made it necessary for her to keep the strictest seclusion, and forced her to arrange for an immediate sailing on emergence

Professor Einstein has had much the same experience He came to this country in the interests of Zion He must have realized that it is only through relativity that his name and support are of value, so he must have expected to talk about relativity as well as about Zion But where in the case of Mme Curie every subject under the sun was set out, Einstein found it impossible to speak through the newspapers on anything but relativity After talking for hours to the newspaper men, everything he said about Zion was ruthlessly suppressed, every chance word which his artful interviewers could wring out of him on relativity was strung out into a paragraph. And everything he was represented as saying is said better in his book' This single experience was enough for Einstein, after it he met no reporters, and his only contact with the press was through prepared statements—a program made possible by the large and efficient organization in whose hands he was Our good friend Dr. Adams of Princeton was not so fortunate, the week which Einstein spent at New Jersey's seat of learning he spent in the woods on his horse, eluding the reportorial hordes who sought to get out of him what they couldn't get out of Einstein

Our own attention has been attracted to this situation, we may as well confess, through our having been made the vicarious receptacle for the wrath and disgust of the two distinguished foreigners We couldn't get an interview with Einstein because we didn't go out to meet him in an airplane, but waited until he had got decently settled in this country—and incidentally until he had had his fill of American interviewers We couldn't get an interview with Mme Curie because we tried to be similarly considerate, because we waited until our enterprising contemporaries had got her views on woman's suffrage, and the League of Nations, and prohibition, and the place of woman in the home, and had worn her down to a point where it was a physical impossibility for her to be seen. We shall know better how to conduct such business when next a foreign scientist of note sails for our shores In the meantime, is it too much to hope that our newspapers will make it possible for the next celebrity from abroad to take home a pleasant impression of the United States; and that in time they will even go so far as to draw a reasonable line between what is news and what is not?

Automobile

Motor Car Business Poor in France.—According to the present outlook, motor car manufacturers in France will have little business until trade generally is on its way toward recovery. Meanwhile firms are finding it difficult to tide over the crisis. Some are drifting into new fields; one is making machinery for contractors and marine work, another is hoping to secure a government order for gasoline locomotives.

Preserving Rubber Hose Connections.—The rubber hose connection between the radiator and the cylinder jacket outlet and the pump connections should be covered with shellac at intervals to keep them waterproof and also impervious to the oil and grease that are inevitable around an engine Oil and grease have a tendency to disintegrate and rot the rubber, but shellac prevents these materials from working into the rubber

Preventing Theft of Radiator Caps.—As an outcome of frequent thefts of motometers and radiator caps, an accessories manufacturing company is putting on the market a new cap that is locked in place by an eight tumbler lock with over one thousand key changes and no master key, precluding the possibility of professional thieves being provided with one or a set of keys to fit it. The action of the lock forces a hardened steel bolt into a slot in the adapter ring, which is secured to the radiator neck by three cup point set screws, seated from inside the ring These screws are forced tightly into the inside of the neck by means of an "L" wrench furnished with the cap The adapter fits all radiators with screw caps except a few with caps of abnormal size.

New Air Filter Has Self-Cleaning Features.—An air cleaner in which felt is used as a filtering medium has recently been placed on the market The device consists of a cylindrical, perforated shell, into which is fitted an elongated spider formed of wire screen and covered with felt The central portion of the spider communicates with a central tube, through which the clean air entering the carburetor flows The felt-covered surface spider is said to have an area of over 500 square inches The area of the inlet holes being large, the entering velocity of the air is low and consequently the larger particles of dust are allowed to settle out before the air passes through the felt. It is claimed that the air entering the cleaner does not strike directly upon the filtering material and that the dust which collects on the surface of the felt is shaken off by the vibration of the vehicle on which the cleaner is used. The dust shaken loose drops out of the shell through holes in the base

Kerosene Not Always an Economical Fuel. — Despite its lower cost, kerosene is not a cheaper fuel than gasoline unless great care is taken in the design of the engine using it In stationary gasoline-engine practice it has long been the rule to figure on a consumption of one gallon per 10-hour day per horsepower, which is equivalent to 10 horsepower-hours per gallon Considerably better results are possible under specially favorable conditions. But in a trial of tractors at Lincoln, Neb, the average of sixty-five tractors tested was only 4.5 horsepower-hours per gallon There is just as much energy in a gallon of kerosene as there is in a gallon of aviation gasoline, slightly more, in fact That the fuel economy of tractors is only about 50 per cent that of fairly large stationary gasoline-engines is due chiefly to two causes Low compression must be used with the kerosene to prevent knocking, and a good deal of the kerosene either passes through the engine unburned or else burns so late in the power stroke that practically none of the heat of combustion can be turned into useful work

Metal Truck Bodies.—For some reason, metal construction has not made as much progress to date in connection with truck bodies as with passenger bodies, although the service conditions in truck work are much more severe. There has recently appeared on the market an all-metal truck body made in Kansas City, in the production of which the electric welding process plays an important part. The body is practically one piece, for the individual parts are welded together electrically The longitudinal sills and cross sills are formed into a girder-like structure and provide a rigid bed to which the body itself is welded. This construction produces a body with a smooth interior, which is an advantage when hauling clay and similar materials, as there is then very little tendency for the load to adhere to the body when the latter is tilted. Another feature is the double acting tail-gate which can be opened either from the bottom or the top. When opened from the top the two cotter pins are removed with a minimum of time and effort, and the opening may then be regulated by the adjusting chain.

Astronomy

Changes in the Crab Nebula.—Dr V. M. Slipher, of the Lowell Observatory, reports that changes in the structure of the Crab nebula in Taurus have been detected by Lampland on negatives taken with the 40-inch Lowell reflector. These observations are based on examinations of 15 photographs covering an interval of eight years

Astronomical Postcards.—Picture postcards presenting charts or views of celestial objects are now issued by at least two publishers in Germany, viz, the Verlag für Technik und Wirtschaft, of Naumburg, and Henry Grand, of Hamburg-Altrahlstedt In the latter case they include star maps for the twelve months of the year, views of the moon, and pictures of nebulæ and star clusters.

Sunspots in 1920.—The last maximum of sunspots was in 1917 During 1920 spottedness continued to decline, the mean daily spot area for the year being about 700 millionths of the sun's visible hemisphere, or half of that of 1917 On a few occasions, especially during August, the solar disk was practically free from spots, while on some days in January and March the total spotted area was more than 2,500 millionths

A Municipal Observatory.—The city of Des Moines has recently acquired a municipal astronomical observatory The city council voted bonds for its erection and provided a site in a park, while Drake University agreed to equip the building with an $8\frac{1}{4}$-inch telescope and other apparatus and to take charge of and man the establishment. The observatory, which is admirable from an architectural standpoint, is open to the public at least two evenings a week and one afternoon.

Completion of the Hooker Telescope.—Dr Hale's last annual report, as director of Mount Wilson Observatory, states that with the completion of the observing platforms at the principal and Cassegrainian foci and the installation of the constant-temperature control system for the 100-inch mirror, the great Hooker telescope—the largest in the world—is now essentially complete, though "work on its accessory instruments will be continued as long as new and promising devices are in view"

Proposed Publication of Star Charts.—The American Association of Variable Star Observers is planning to supply its members and others with sets of photographic reproductions of the charts of the Bonn Durchmusterung, provided enough subscribers can be obtained at $16 a set The complete set will include 64 charts, approximately 8 by 10 inches in size Further information on this subject and a sample chart can be obtained from Mr D B Pickering, 171 South Burnett St, East Orange, N J

Lunar Zodiacal Light? — Dr. W E Glanville, of Solomons Md, reports to the British Astronomical Association that on Feb 21, 1916, he made a successful observation of the "moon's zodiacal light," reported by Jones and other observers At the time of observation the gegenschein showed on the ecliptic At 8 15 a distinct luminosity, fainter than the sun's zodiacal light but in the usual shape of the latter when near the horizon, was visible from the moonrise point (over Chesapeake Bay), reaching the southern boundary of Leo up to the gegenschein, which became commingled with the light The luminosity persisted until moonrise at 8 40 Mr *Gavin Burns, director of the aurora and* zodiacal light section of the B A A, remarks on this observation "As the light of the full moon is only about one-millionth the intensity of sunlight, it is difficult to believe that the phenomenon described can be due to the light of the moon"

Minor Planets in 1920.—Thirty-nine minor planets were discovered in 1920, of which 16 were discovered by K Reinmuth, of the Königstuhl Observatory, Heidelburg, and the rest by Dr Baade, Hamburg, Messrs Gonnessiat and Jekhowsky, Algiers, R T A Innes, Johannesburg, Dr Palisa, Vienna, Professor Schwassmann, Hamburg, Prof. Comas Sola, Barcelona, and Professor Wolf, Heidelburg Planet 925, found by Comas Sola Jan. 13, 1920, has been named Alphonsina. It was of about the ninth magnitude and was extensively observed for four months The object 1920 HZ, found by Baade Oct 31, has an orbit of a cometary character. The perihelion is near the orbit of Mars and the aphelion near that of Saturn, while the inclination is very large It shows no nebulous envelope on plates taken with an exposure of half an hour, so that it is difficult to apply the name "comet" to it Planets 469 Argentina and 583 Clotilda, which had been missing for some years, were recovered in 1920. Planet 99 Dike gave evidence of variability of light The Trojan planets Hector and Nestor were observed by Dr Baade in March, 1920.

Aeronautics

A Parachute Record. — To Lieut Arthur Hamilton of the U. S. Army, goes the record for parachute jumps, for he recently left an airplane at a height of 24,400 feet and drifted eight miles before touching the ground He is said to have fallen asleep from cold during part of his descent

The Schneider Giant is referred to in a recent issue of *L'Air* as a biplane of some 100 feet spread, which will weigh about eight tons This French machine will be equipped with four 400-horsepower motors arranged in two tandem pairs But the real feature of novelty is that this plane has been designed to carry a 3-inch cannon

Advantages of Thick Wings.—During a visit to the Junker factory at Dessau, Professor Junkers, in demonstrating his method of obtaining wind tunnel results, drew attention, while discussing the experimental results of "thick" wing sections, to the fact that the employment of a thick section restricted very considerably the movement of the center of pressure Statements by German "Junker" pilots to the effect that the "Junker" was exceptionally steady in bad weather would seem to corroborate this statement.

Fireproof Cover for Gas Tanks.—One of our leading rubber companies has developed a fireproof cover for the gasoline tanks of airplanes, which has been accepted by the Government for use on combat and mail planes The cover was designed primarily for combat airplanes for protection against incendiary bullets and is not only fireproof but leakproof and crashproof as well The cover consists of a sheet of soft but very tough rubber, one half inch thick, laid on several plies of high grade cotton fabric The rubber is applied next to the tank In tests, it was found that when the gasoline tank is punctured, the rubber immediately closed the hole and stopped the leak

Italy's Zeppelin Experience has not been an altogether happy one It appears that the "L-61", which was safely delivered by a German crew to Italy, in accordance with the terms of the Peace Treaty, has sustained such damage that it will have to be broken up Furthermore, it appears that while in a trial flight, owing to an unexplained failure of the steering-gear when landing, the airship sustained a considerable amount of structural damage, three members of the Italian crew being killed and several others severely injured The Italian authorities applied to German aeronautical engineers for extra parts and technical services, but were refused help of any kind Hence Italy has decided that the "L 61" had best be scrapped

Pullman Air Service.—The Royal Dutch Air Service, which is a private enterprise aided by the Dutch Government has commenced operating a luxurious airplane service between Croydon (near London), England, and Dutch cities These flying "Pullmans provide softly cushioned armchairs, with writing tables for each passenger, and the interiors of the cars are fitted with satinwood panels mirrors and so on The arrangements include one departure each day from Croydon at 10 A M, halting at Rotterdam for 15 minutes, and continuing to Amsterdam The fare from Croydon to Amsterdam is £10 10s Between the latter place and Copenhagen air connections are provided The through fare to Copenhagen is £34 6s

Sewn Plywood.—In England there has recently appeared a special plywood material for aircraft construction This material, we are told, must not be confounded with ordinary plywood, for it is something infinitely superior It is a super-plywood, so claims its manufacturer, which is actually sewn together The layers are first cemented together with waterproof material and then stitched through in parallel rows about $1\frac{1}{4}$ inches apart This gives a rigidity and resilience unattainable by any other method Weight for weight, it is the strongest material yet evolved The sheets are made to any desired size or shape up to 8 feet wide by 60 feet long, and from $\frac{1}{8}$ inch to $\frac{5}{8}$ inch thick, thus eliminating waste in the conversion

The Navy Design Competition.—In the first open airplane design competition to be conducted by the Navy Department five designs for a new type of naval plane have been accepted on preliminary examination out of forty submitted by thirty corporations and individuals, we learn from *Aerial Age Weekly* The competition was held to develop a type of plane specially suited for use in spotting and control of battleship gun fire at sea. The five designs, including one each submitted by the Curtiss Company and the Dayton-Wright Company, will be subjected to a final examination to determine the order of merit of the best four These will be purchased at sums ranging from $16,000 for the best to $8,000 for the fourth

Strip of animated drawing cartoon, showing the action of an automobile vacuum-feed system. The "mechanigraph" employed for this film is shown below

Putting Motion Into Mechanical Drawings

How Motion Picture Films of Hidden Mechanisms Are Made for Industrial and Educational Purposes

By Howard Greene

OF all the methods that ever have been devised for instructing and entertaining the public, the motion picture stands first in adaptability and flexibility The public have become accustomed to trick photography, which seems to make impossible things happen before their eyes the wildest flights of imagination can readily be made realities - photographically, at least

While the fullest advantage has been taken of all these facilities of motion pictures in providing amusement for the audiences that throng the motion picture houses, there has been far less activity than there might have been in making use of "movies" for educational and advertising purposes A certain conservatism, where conservatism might least be looked for, has manifested itself, with the result that the most potent of all methods of making complex matters simple has been neglected to an astonishing extent Not that there are no films made for instruction and advertising, it is quite true that some have been produced and that they have admirably fulfilled their missions But this simply makes it all the more a matter of wonder that the supply of films of this nature is as slender as it is, for the field is limitless and the possibilities almost beyond imagination

Let us explore a little in one corner of the vast field that will some day be completely covered through the agency of the motion picture A manufacturer of automobiles, we will assume, desires to get before the public the complete story of his car Or an institute of technology or some other educational institution desires to make the construction and operation of the automobile absolutely clear and understandable It is desirable to save time in imparting knowledge and to create an impression that will be lasting and accurate and that will not be the result *of tedious mental drudgery How is it to be done?*

A specialist in the making of mechanical motion pictures is consulted, the objects sought explained, the data supplied The making of the picture is commenced

It is a simple enough matter to make, in the usual way, moving pictures of all parts of the car that are visible It is equally simple to dismantle the engine, or the gearset, or any other unit, then to photograph the various parts and, in some cases, to show them in motion But to make clear the actual action under working conditions is a different matter altogether Take, for example, the familiar vacuum system for keeping the carburetor supplied with gasoline All that is visible is a little tank and a few pipes Lay bare the working parts and they will not work Some recourse must be had to a series of drawings, supplemented by verbal or printed explanations In the last analysis the whole matter simmers down to the ability of the instructed to use the imagination and so mentally to visualize the apparatus And it requires something more than an average imagination *first to comprehend the analysis* and then mentally to construct and finally mentally to operate the system

Your motion picture engineer makes it his business to sweep away these difficulties, to eliminate the mental drudgery and to get at once to the heart of the subject—to show what the machine is for, what it consists of and how it works when the car is running

Overhead at *B*, is the camera, and just to the right of it, *A*, is the electric motor, reduction gear, trip mechanism and reversing switch The mercury-vapor lamps in suitable and adjustably mounted reflectors appear at *C* The mechanigraph" is shown at *D* A counter, chain-driven from the shaft indicates number of exposures made

How the mechanigraphs are filmed by means of the animating stand

And, be it said, in doing this he takes upon his shoulders a task of no mean magnitude, which has a good deal to do with the fact that such pictures are not more common than they are

At this stage of the proceeding another consideration enters. When the motion picture was in its early youth any picture that moved on the screen was acceptable After the proverbial nine days, however, people became more discriminating, they *demanded—and* were given—pictures with an appeal beyond that of mere moving photography Later there appeared the animated cartoon—the comic line drawing in which the characters and "props" moved in a more or less lifelike way As a novelty, this was popular for a time, but the novelty soon wore off, and the animated cartoon is fast giving way to pictures that, while still designated as cartoons, have all the earmarks of being motion photographs of real things They are produced by highly complex systems of double exposure, rephotographing photographs and so on The old line drawing idea has had its day, and its place has been taken by a picture that *looks precisely like what it is intended* to represent

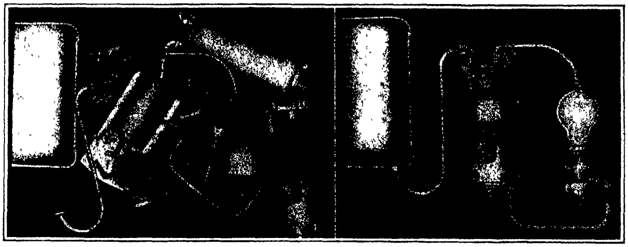
So it is with the instructive and educational mechanical picture In its best known form it has been chiefly an animated line drawing While satisfactory in some respects, such a picture is lacking in the very important element of reality It is a representation of an idea, rather than a picture of the thing itself Consequently, the present endeavor is to incorporate in the picture every possible appearance of actuality And, to go back to the vacuum fuel-feed system, the end is accomplished as follows·

A drawing is made showing the system in cross section, taken at a point that exposes all the working parts *Separate drawings are made of all the moving* parts, all exactly to scale and of the correct form All the parts are painted until they look quite real. Here a special knowledge of tone values is highly important The tinting and shading that make an excellent halftone cut, for instance, will often fall short of the appearance of reality when photographed under the motion-picture camera For that reason, illustrations of the work are usually far less convincing in appearance than the images projected on the screen

All the parts are assembled, joints and bearings being used so that they will move as they should. It is usual to make also toned drawings showing all exteriors, to show the external appearance of the apparatus at the beginning of the picture. These exteriors are "dissolved out" later, exposing the working parts

Photographing the

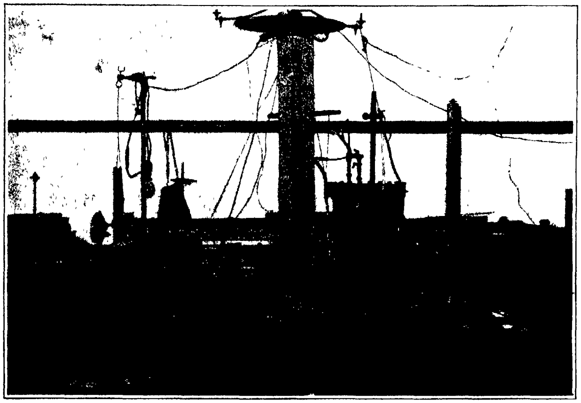
(*Continued on page 477*)



Parts of vacuum-feed system mechanigraph, properly drawn and tinted, and assembly of parts ready for filming

Counting Electrons

By Ralph Howard



Professor R. A. Millikan's apparatus for counting electrons

MEDIEVAL theologians have been ridiculed because they debated how many angels could stand on the point of a pin. Prof. R. A. Millikan of the University of Chicago gives science's answer to a modern problem that is more or less comparable with this one when he isolates and measures an electron, and he has recently been catching individual atoms and counting the number of electrons which each one has lost when an alpha particle from radium shoots through it. Science for some time has divided the "indivisible" atom into its constituent parts, and identified these as electrons, but Professor Millikan is the first to catch and exactly measure the charge carried by each one of these.

This charge is so small that the number of electrons contained in the electricity which courses through a 16-candle-power lamp filament, and for which we pay one hundred-thousandth of a cent, is so large that if three million people began to count them at the rate of two a second without stopping to eat, sleep, or die, it would take them twenty thousand years to finish the job.

An electron weighs, according to Professor Millikan, very *nearly one billionth of a billionth of a billionth* of a gram. Divide this by 500 and you get its weight in pounds. But Professor Millikan has these electrons well under control. He can count the exact number of them which he has caught in a minute oil-drop, with quite as much certainty as he can enumerate his fingers and toes.

In measuring and counting electrons you might imagine one would have to use a pair of scales so small as to be invisible to the naked eye. But Professor Millikan's apparatus is a rather bulky affair. It must weigh several hundred pounds, and it looks like a combination of a magic lantern and a water tank. A 400-watt bulb is installed in a tin box equipped with a strong lens. A water filter a few inches from the lens weakens the heat waves. The light illuminates a tank within another tank, surrounded by a sea of oil. The inner tank contains a partial vacuum, the pressure varying from one one-thousandth of an atmosphere up to an atmosphere.

At the bottom of the tank are two circular condensing plates, the upper one perforated by tiny pinholes. A mist of atomized oil, charged with frictional electricity, is blown through the pinholes between the plates. A high-potential battery is at one side, the negative terminal attached to the upper plate and the positive to the lower. This battery supplies a current of about 1,000 volts. A drop of oil suspended between the two plates travels upward or downward as a reversing key is moved. With a suitable adjustment of the potential it remains stationary moving neither up nor down. In this position the capture of a positive charge makes *it travel upward, of a negative downward.* In the recent experiments a radioactive material—in this case polonium—shoots atoms of helium (alpha particles) beneath the drop. Within the tank is a gas, usually helium. One turns a lever so as to expose this gas to the radiation and it is at once shot through by billions of infinitesimal projectiles, atomic cannon balls. It is these that do the damage.

Now atoms are made up of positive and negative electrons. The positive ones are packed very tight together into an exceedingly small central nucleus, which constitutes the sum of the atomic system. This is surrounded by negative satellites or electrons, which make up the perfect balance of an ordinary neutral atom. But if helium atoms (alpha rays) are going with sufficient speeds, millions of them can shoot through the wall of a thin glass tube without leaving any holes behind. This means that it is possible to shoot one atom right through another just as some giant might gather up an entire solar system and send it whizzing through ours. But when this is done one or more of the constituent electrons of the system is likely to be detached. When one or more of its electronic spots have thus been knocked out of an atom, it is not quite the same as before for it is no longer electrically neu-

(Continued on page 478)

Diagnosis by Wireless

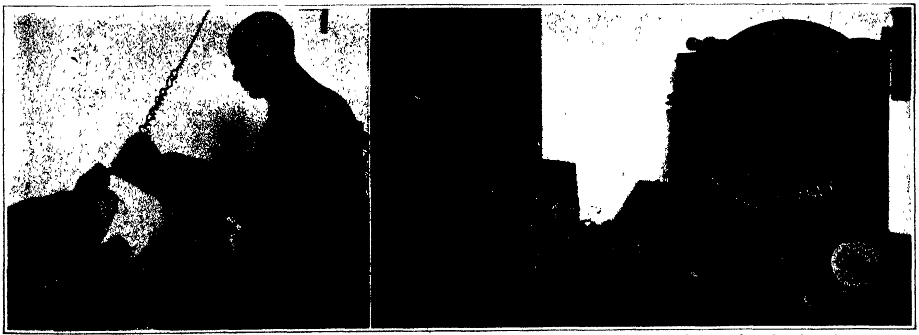
By S. R. Winters

PALPITATION and other troubles of the heart may be diagnosed even though the patient be far removed from medical facilities—say, in middle of the Atlantic Ocean—by application of "wired wireless," the notable discovery of Major General George O. Squier, Chief Signal Officer of the United States Army. The principle involved is similar to that which made possible the multiplication of the volume of the inaugural address of President Warren G. Harding on March 4, the human heart beats being amplified thousands of times.

A demonstration recently to a group of physicians of the United States Army at the Signal Corps Laboratory, Washington, D. C., for the first time revealed working plans of the remarkable innovation. A heart transmitter designed for the specific purpose resting by its own weight over the heart of the subject under examination, was placed in position. Passage of the blood through the various valves of the heart is responsible for vibrations in an air chamber which faithfully reproduce the manifold actions of the blood when coursing through the valves of the heart. These, in turn, are conveyed over a wire—practical application of "wired wireless"—*to an amplifying equipment consisting of* a group of standard vacuum tubes used by the Signal Corps. The tubes are not dissimilar to those employed in wireless telephony and telegraphy reception.

The vacuum tube amplifiers then actuated a special *receiver attached to a large horn which distributed* sounds reflected by heart beats throughout the building. Doctors attending the novel performance discussed among themselves the peculiarities of the hearts of different subjects as the actions were magnified. Distance is an irrelevant factor when heart beats are to be studied by the vacuum tube amplifier. The high frequency carrier current, a distinguishing feature of the progeny of Major General Squier when compared with radio in common transmits sounds along a wire by means of electric waves guided by an ordinary telephone line. Thus, there is established a perfectly silent vehicle for conveying the delicate variations of sound produced by the heart to the receiving apparatus.

Comments of physicians attending the demonstration were of a varied character as to the practical application of "wired wireless" in diagnosing heart diseases. An occasional opinion was to the effect that the use of magnifying equipment would involve the refashioning of medical education as it pertains to the study of the heart. Other army doctors were unreserved in praise



The transmitter (left) and amplifier (right) used in sending out by wireless the heart record of a patient on board a ship where there is no doctor

Below Zero

The Low Temperature Laboratory of the United States Bureau of Mines

The air purifiers and the storage tanks for hydrogen and helium

WHEN the plants for extracting helium from natural gas were started in 1918, owing to the pressure in connection with all war undertakings, there was no time nor opportunity to do any research work on a small or semi-commercial scale It was necessary to design and build the plants as rapidly as possible, and to do whatever experimentation was required in the plants themselves Shortly after the two experimental units at Fort Worth were operating, the advisability of research work in connection with the undertaken was plainly seen, and some vapor-pressure work was started at the Bureau of Standards under a coöperative arrangement with the Bureau of Mines and the Army and Navy Last year arrangements were made with Dr Harvey N Davis, of Harvard University, and Dr F G Keyes, of Massachusetts Institute of Technology, to do further work along this line, and this is now in progress. There is, however, a distinct addition in having a thoroughly equipped laboratory which is available at all times for research work in connection with the plants and this has been accomplished through the establishment this year in the Bureau of Mines at Washington of a Cryogenic Laboratory The funds were allotted to the Bureau of Mines last June through the interest of Commander A K Atkins, of the Navy, and Colonel C DeF Chandler and Lieutenant R S Olmsted of the Army Air Service, and at the present time Lieutenant Commander S M Kraus and Major P. E Van Nostrans are acting for the Navy and Army, respectively, under the cooperative agreement with the Bureau of Mines

The equipment is now installed in the new Department of Interior Building at Washington It consists of two 4-stage Norwalk air compressors, rated at 75 cubic feet of free air per minute each, compressed to 3,500 pounds per square inch at 135 revolutions per minute These compressors are driven by two 50 horsepower variable speed, 220-volt, direct current motors These compressors will be used for making liquid air and for obtaining the necessary refrigeration for other purposes From 15 to 20 liters per hour of liquid air can be obtained In addition, there is one 3 stage submarine type compressor, rated at 28 87 cubic feet of free gas per minute at 150 revolutions per minute, compressed to 3,000 pounds per square inch, and driven by a 15-horsepower variable speed 220 volt, direct current motor, also one 3-stage submarine type compressor, rated at 16 cubic feet of free gas per minute The first one will be used for liquefying hydrogen and the second one for a liquid helium cycle All the compressors have unloading valves so that the capacities can be varied within wide limits

There are two 300 cubic feet and one 200 cubic feet gas holders for holding hydrogen and helium, four smaller holders for storing gas samples, a machine shop equipped with 13-inch engine lathe, bench lathe, shaper, two drill presses, grinders, pipe tools, etc There is also available one low temperature expansion engine, air and hydrogen liquefiers, and the necessary physical and chemical apparatus to go with the above equipment

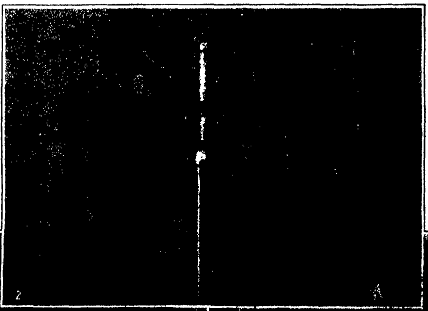
The object of the laboratory is two-fold Its first and main object is to obtain scientific data that will be of use in the operation of the helium plants so as to get more efficient operation, and reduce the cost of helium production. Its second and subsidiary use is to furnish facilities to a limited number of American scientists who may be interested in using the laboratory for special low temperature work, particularly along lines that will not be covered by the technical men of the Bureau of Mines.

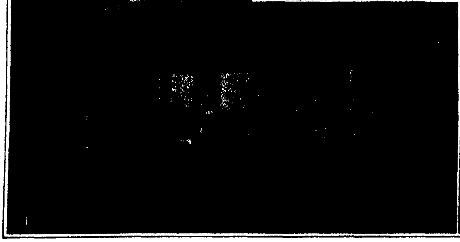
At the present time the work that is being carried on is along two definite lines First, vapor pressure work in connection with ternary mixtures, and secondly, in connection with the purification of helium by means of charcoal at low temperatures It has been found that charcoal at low temperature has a selective action on nitrogen absorbing this gas, but not absorbing helium, or at least to only a very small extent This property has been adapted to purifying helium both from nitrogen and from air.

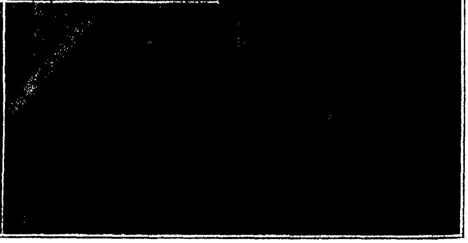
The Army has constructed a repurification outfit on two railroad cars. The first car contains the power plant, and the second car contains the compressors and refrigeration equipment. The Bureau of Mines has been asked to design and install a charcoal repurification unit on this car, and this work is now under way, the equipment being partially constructed in the Cryogenic Laboratory, and the whole will be tested out in this laboratory before installation in the car If this work is a success it is probable that it will be of sufficient value to install in the production plants also in order to step up the cruder product which is obtained in the plants to 10 per cent helium, which can be obtained by means of the charcoal. The importance of having the higher product is exceedingly great as a dirigible filled with 100 per cent helium rather than 94 per cent will have a much greater lifting power, and also a wider range of operations. It appears as though helium, after all, may come into more general use for dirigibles, in place of hydrogen

Eye-Strain and the Movies

A COMMITTEE appointed by the Illuminating Engineering Society of England to inquire into eye-strain resulting from watching the movies, has just made its report, which is published in the *British Medical Journal* The committee finds that the chief strain on the eyes comes from the pictures being shown too high up, so that the eyes of the spectators in the front rows have to be raised It recommends that the height of a picture on the screen be such that the angle formed by lines from the center of the top and the center of the bottom to the eye of a spectator in the front row be not greater than 35 degrees.

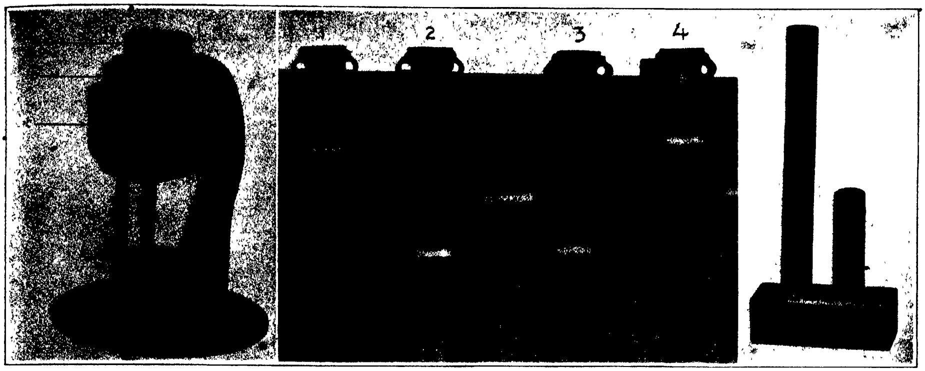






Left· General view of the low-temperature laboratory. *Right* Four-stage air compressors that work up to 3500 pounds pressure. *Above*: The hydrogen and helium compressors

Where the Bureau of Mines investigates low-temperature problems



Left· Test to show porosity of the new bearings. *A* is a brass weight, *B* the rod of genelite, *C* the tank from which the oil is being 'siphoned to the tank below *Center* Genelite bearings of a four-cylinder car after 20,000 miles. *Right* The relative amount of graphite in the new bearings, the small column representing the volume of graphite and the large one that of the entire substance

Tests and demonstrations of the new self-lubricating bearing material

Self-Lubricating Bearings

A NEW bearing material which is a mixture of graphite and high-grade synthetic bronze, and which has self-lubricating qualities of a high order, has recently been developed in the G. E Research Laboratory following successful tests under service conditions. Perfection of this material—genelite—came after research extending over a period of several years

The new material contains graphite amounting to 40 per cent by volume of the whole mass. Tests have shown a high degree of porosity, the metal being able to absorb as much as 2½ per cent by weight of oil One of our illustrations shows a piece of apparatus set up to demonstrate this feature of the material Oil from the upper beaker is siphoned into the lower through the rod of genelite and the woolen wick This characteristic is made use of in high-speed applications where oil is applied to the outside of the bushing and carried through to the bearing surface by capillary attraction Another characteristic is that the bearing never siezes or freezes, that is, the metals of the shaft and the bearing never flow or weld together. If a bearing sticks, owing to too close a fit, all that is necessary is to reassemble it with the proper fit, no damage being done to the shaft or bearing We illustrate the crank pins and main bearings of a well known make of automobile after 20,000 miles' service, the crank pins being equipped with these bearings The main bearings were badly worn as seen from the grooves in the shaft and the appearance of the babbitt, while the crank pins are barely polished, and the genelite bearings in the big ends of the connecting rods have not yet come to a full seat

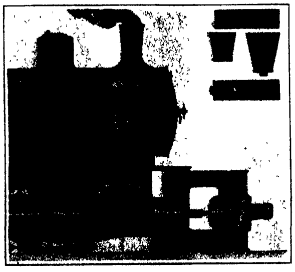
Among the self-lubricating uses for the new bearing are brake-rod bushings, clutch-centering bushings, throttle control, fan and pump-shaft bushings, where such material saves much trouble and expense of overhauling and repair. On the main engine genelite has proved useful for places such as main bearings, crank-pin bearings and piston-pin bushings, which are supposed to be well lubricated at all times, but where wear is likely to be excessive

The metallic component of the new bearings is made from the oxides of tin, lead, and copper, composing a high grade bronze, all the materials being in a finely divided state. Graphite is added in sufficient excess quantity to reduce the oxides to the metals, and leave the required graphite content in the finished material

The mixture, still in powdered form, is then pressed as nearly as possible to the required shape in massive metal molds. In this pressed form it will not stand much rough handling, so it is given a final bake, which sinters the metals together into a homogeneous bronze, holding the graphite uniformly distributed throughout its mass. We show a photomicrograph that brings out the even distribution of the graphite particles. The white spots are the bronze and the black ones the graphite. The baking serves to clamp the graphite particles securely within the mass of bronze so they cannot be washed out or detached save by dissolving away the surrounding metal with acids.

Photomicrographic cross-section of the new bearing, showing uniformity of mixture. The black is graphite, the white bronze

The material has the general appearance and body of bronze, but the characteristics are different It does not machine readily, but can easily be ground, which has been found to be the best method of handling it. Neither has it the physical characteristics of bronze, having very low tensile strength, but withstanding high compressive strains



A steam locomotive doing emergency service as a punch-press, and the four stages of the work turned out with its aid

A Steam Locomotive as a Punch-Press

A VERY ingenious device, used in France for drawing down 75-millimeter steel shells during the war, was described recently in the proceedings of the Societé des Ingenieurs Civils de France A curious fact is that a locomotive plays the principal rôle

According to the account, the Bordeaux works of the South of France Railway Company, like all other works in France, were called upon at the outbreak of war to adapt a portion of their machinery to the making of the "75" shells, starting from steel bars cut to length as shown at 1 These were upset hot in a die and given successively the shapes shown at 2 and 3, in upper right-hand corner of drawing

The cup thus obtained had to be drawn down to the cylindrical shape shown at 4, and for this the Bordeaux works had no machine available Considering the time it would have taken to build, or to await the delivery of, a hydraulic press for the purpose, they looked around for temporary means of increasing the shell supply At first it was thought that the drawing-down operations might be done in a spring-testing machine, but it was soon realized that this machine was unable to give the required 80 ton to 100 ton pressure Attention was then turned to a powerful modern locomotive engine built for service on heavy gradients, which happened to be lying idle pending repairs A trial was rapidly prepared for which the locomotive was moved to a position in front of a stout wall on which the drawing down die-holder was supported The locomotive was then raised so that the wheels were clear of the rails, and a punch was fitted to the tail rod of one of the pistons A cup was then heated to a red heat and placed in the die, when the opening of the regulator-valve drove the punch forward and caused the cup to pass through the die The test being successful, it remained necessary only to make the installation more convenient for use

The manner in which this was accomplished is shown in drawing The buffer beam of the engine was replaced by a much stronger one, built up of plates and sections, and fitted, in front of the cylinder utilized for the drawing-down operations with the die holder, a kind of casing open at the side for inserting the die A catch against which the die butts horizontally when it is inserted fixes it in a suitable position so that the axis of the die is on the same vertical plane as the axis of the piston, the die being further supported on the lower part of the casing in such a way that its axis was slightly lower than the piston axis As was done when machines specially designed for this operation were used, the reduction was effected in three stages, each using a smaller die than the preceding one.

The cups were heated in a reverberatory furnace erected close to the locomotive On leaving the furnace, the base of the cup was slightly cooled by immersion to a depth of from 2 to 3 centimeters in a tank of water maintained at a constant level At the same time, the bottom of the cup was freed of scale by means of a kind of milling cutter worked by a small portable

(*Continued on page 478*)

An Alternative to Einstein

How Dr. Poor Would Save Newton's Law and the Classical Time and Space Concepts

By the Einstein Editor

ON our editorial page for May 14th we spoke harshly of those who criticise Einstein as a plagiarist. There is another kind of criticism that is on a different and an altogether respectable basis. Regardless of *ultimate acceptance or rejection*, Einstein's pronouncement is a great scientific achievement. He has laid down a series of postulates of extreme interest, and has derived from them consequences of equal interest and importance. Nothing that we may subsequently learn of the realizability of his postulates or the occurrence of their consequences can in any way detract from his work. But while retaining all admiration for the structure and the labor that went into it, *the scientist may still question both realizability and realization*, or criticise Einstein's theories on any other scientific ground.

In this spirit Dr. Charles Lane Poor in the SCIENTIFIC AMERICAN MONTHLY for June, asks, and answers in the negative, the questions "Is Einstein's system the only set of assumptions that will explain the phenomena on which he relies for verification, and if not the only set, is it the best set?" Dr. Poor finds the demands made by relativity upon his "common sense" a little too great for his ready submission; he seeks an alternative which shall not so offend. To his own satisfaction and we expect to that of many readers, he finds a way of saving the conventional notions of time and space, and with them Newton's law of gravitation.

Dr. Poor points out that to establish the Einstein theories it will not be enough to show that they explain *the facts of nature*. We must at least attempt to show that no other hypothesis will do this equally well. Of course in practice we should hardly hope to accomplish this with complete rigor; we should in any event have to descend to the choice of that cosmological system seeming to have the most in its favor when we come to weigh probabilities. The average physicist we believe will prefer Einstein's explanation to Newton's as bolstered by Dr. Poor, for the very reason set forth so ably by one of our essayists—that the one is a generalization while the other is limited in its scope to the particular problem that brings it up. Be that as it may, Dr. Poor must be met on his merits, and because of the extreme interest of his suggestion we give him space to set it forth in the MONTHLY, and make this résume here.

AS the Einstein theories are surveyed, with the passing of time, more and more in the light of cold reason and less in that of emotion, it becomes increasingly plain that the evidence in their favor is entirely internal. The Michelson-Morley experiment itself has had such doubt cast on it, in view of recent discoveries as to the behavior of metals, that it seems necessary to perform it anew in a manner that shall make it less dependent upon the properties of the material apparatus. The eclipse observations, useful as they were in focusing popular attention upon the theory and its "verification," are so unsatisfactory that the eclipse of 1922 is to see further work in this direction which is designed to replace rather than to supplement what was done in 1919. The spectral shift is so tangled up with similar effects from other causes and with observational difficulties that it seems doubtful whether it will ever amount to anything as a test. Wherever we attempt to check up Einstein, we find that accidental and systematic errors of observation and calculation bulk such a large percentage of the effect we are trying to observe, that we cannot be certain whether favorable results are the result of the effect or of the error, or whether an unfavorable outcome is to be accepted as significant. Dr. Poor now completes the case by showing that even in the matter of Mercury's perihelial advance, of which the Einstein proponents have made such a point, acceptance of relativity is only to be put on the ground that we want to accept it, and not at all on the ground that we have to. Everybody, the pure physicist who feels that he simply must have the Einstein theories as well as the man of hard, classical common sense who doesn't see how he is possibly going to reconcile himself to them, will be interested in what Dr. Poor has to say in the SCIENTIFIC AMERICAN MONTHLY *for July, and in the Einstein Editor's present comments on this paper.*—THE EDITOR.

For many years Newtonian theory has failed to account for the behavior of Mercury. If this planet were alone in the skies with the sun according to Newton his orbit would be a perfect ellipse, quite fixed relative to the sun. With the other planets accompanying him in his flight, this ellipse instead of being fixed should push its sharp end slowly about so that after many revolutions the orbit would point in an observably different direction. This "advance of the perihelion" (the sharp end of the orbit) should amount to 537 seconds of arc per century.

Under Einstein's theory this advance should still take place, but in addition there should be a further advance of 42 seconds per century, *independent of the other planets*—an advance which would occur even if Mercury were the only planet. We actually observe an advance in Mercury's perihelion of 579 seconds per century, the sum of the pure Newtonian and the Einsteinian advances. Einstein appears to be brilliantly verified. But the whole story has not been told.

The situation that exists with regard to Mercury exists in the cases of all the other planets. Only, because in no case is the *orbit so sharply elliptical* as Mercury's, and because the other orbital speeds are much less than his, the magnitude of Einstein's effect is less in the other orbits and precise location of the perihelion more difficult. At the same time the Newtonian advances of the other planets are mostly much larger than for Mercury, so that for them Einstein's *corrections are a small percentage of the total observed advances*. Their importance has therefore been minimized on the ground that the margin of observational error swallows up the predicted correction.

Dr. Poor makes it appear that the discrepancies between Einsteinian prediction and observation are not so negligible as they have been represented to be. He shows that while Einstein accounts for practically all the divergence between observation and calculation in the case of Mercury, and markedly reduces the discordance in the case of the earth, he accounts for a very small part of Mars' failure to maintain his schedule, and actually makes the case of Venus, already bad enough, more than twice as serious.

Moreover, the perihelia are not the only features of the orbits that misbehave in a manner which Newton has not been able to account for. The inclinations and the positions of the nodes (the points where the orbits *pierce the plane of the earth's track*) *fail to check up*, by anything from zero in the case of Mars' node to ten per cent in the case of Venus' inclination. And Einstein offers neither help nor hindrance; his results here differ in no respect from Newton's.

Simon Newcomb made an exhaustive study of the possibilities in the case of Mercury's perihelion, which has had more attention and been featured more as a Newtonian failure than any of the others. He considered every explanation which had ever been advanced or which he could himself imagine—a group of asteroids inside Mercury's orbit, such a group outside the orbit, the hypothetical planet Vulcan, the matter surrounding the sun and giving rise to the zodiacal light, etc. He investigated mathematically the possibility *of the gravitational influence of any of these* aggregations of matter being enough and not too much to cause the observed effect, and reported in the negative in each instance. He finally concluded that while there was of course no independent evidence in its favor the suggestion that best accounted for Mercury's behavior without disturbing the balance of the universe in any other respect was Hall's proposal to modify the law of gravitation, and make it read "inversely as the power 2 000,000 1574 *of the distance*"—the figure named having been deliberately chosen to bring about the desired result. While this is one of the most striking instances on record of the empirical formulation of a law to suit observed facts, it did not take hold of physicists or astronomers, and they preferred actually to let the problem stand unsolved. This of course is again because of the extremely special character of the explanation offered.

Dr. Poor returns *to the material explanations*, and finds that Newcomb fell into a rather natural error in one part of his work. After correcting this, Dr. Poor is able to present a set of physical assumptions which, under the pure Newtonian law, do all that Einstein's do in the matter of straightening out the planetary discrepancies—which do more than Einstein does, in fact. He starts with the known fact that there is a great deal of matter wandering about loose in the region occupied by the orbits of the minor planets. This does not consist of a continuous gaseous envelope about the sun, but rather of an immense number of separate solid particles, each pursuing its own separate orbit. These planetesimal bodies are of all sizes from that of a pin head up to that of an object measurable in feet or even perhaps in fractions of a mile. We know that this circumsolar lens, as Dr. Poor calls it, exists; the particles are too small to be seen individually but collectively they reflect enough sunlight to us to form the zodiacal light.

In computing the planetary orbits the mutual influences of the several planets have been worked out most carefully—so carefully that when Uranus refused to run on schedule the position and size of the planet beyond him that would be necessary to account for his vagaries were computed with sufficient accuracy to lead to the discovery of Neptune. But no computation of planetary orbits has ever gone further than this. The matter of the zodiacal light has always been ignored on the assumption that its aggregate mass was not sufficient to cause appreciable discrepancies. The astronomer is continually making assumptions of this character, designed to make it possible for him to solve his equations in his own lifetime instead of leaving them as a legacy to his grandchildren; but Dr. Poor now challenges the particular assumption involved in the neglect of the circumsolar lens, and replaces it with a new assumption regarding the mass and density of this lens.

It is not possible, on the basis of present knowledge to determine the quantity of matter that is here present or its approximate distribution. It is however clear that its density must decrease as we recede from the sun. It is then possible to work the problem backward, to do just what Adams and Leverrier did in estimating where to look for Neptune, and to arrive at a distribution of the circumsolar matter that would account for Mercury's observed behavior. Even here, however, we *must* have simplifying assumptions. We cannot introduce into the equations of motion of Mercury the condition, which presumably exists, that the density of the circumsolar envelope varies continuously; we may only approximate to this condition by assuming that it is divided into several zones, each of uniform density. Itself an approximation, this is plainly a vast improvement over the approximation that ignores the lens entirely.

Dr. Poor finds that to account for the facts in the case of Mercury he needs three such zones of gravitating matter, each being assumed of elliptical shape to conform to the general planetary scheme. He has a certain amount of freedom; his equations fix neither the mass, nor the distance, nor the ellipticity, of his several rings, but merely the product of these three. There is then a great range of choice for the three elements themselves, *some* combinations being of course absurd, but many being entirely in accord with the physical possibilities. With the freedom of choice which he has between the latter, Dr. Poor is able to select values for his distances and densities which shall not alone resolve the Mercury problem, but which shall at the same time help out with the discordances of the other planets.

If the circumsolar lens possess the numerical values attained by Dr. Poor, its gravitational influence added to all the previously known factors would account for Mercury's perihelial advance with absolute accuracy, for that of Venus within 0.5 per cent; for that of the

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New Sources of Pulp and Paper

The Direction in Which the Paper Maker Will Turn When His Timber Supply Is Gone

By Thomas J. Keenan. F. C. S.

THE growing scarcity and ascending cost of the raw materials used in the manufacture of pulp and paper are reflected in the prices which consumers are required to pay for the finished product. The larger city dailies appear to be less affected than the country weeklies and trade journals, for the reason, perhaps, that most of them obtain their supplies direct from the paper mills on long-term contracts, or else control mills of their own, the entire output of which is absorbed by them.

The body of all newspaper sheets consists of pulp produced by a mechanical process of grinding logs of spruce, balsam or hemlock against revolving stones in the presence of water. This pulp alone can be formed into paper with the addition of a small proportion of clay, but it is customary to strengthen the sheet by incorporating with the groundwood pulp a definite proportion—10 to 20 per cent—of chemical pulp made by the sulfite process. The preferred wood for the manufacture of sulfite pulp, which is made by boiling the wood under pressure, in bisulfite of lime solution, is spruce, though other woods, as hemlock, balsam fir, white fir and tamarack, are also used commercially.

The spruce and fir forests of the northeastern states, where our pulp and paper industry has had its greatest development, have been practically exhausted, and American paper manufacturers have been forced to seek supplies of this raw material in Canada. The Canadian pulp and paper industry has forged ahead of late years until its production of pulp and paper has reached enormous proportions, putting pulp and paper manufacture at the head of all the Canadian industries.

In addition to the pulp manufactured in our own mills for conversion into paper, a large volume is now imported from Scandinavia and Germany, as well as from Canada, our home production being wholly inadequate to meet the demands for the many kinds of paper which are manufactured in addition to newsprint paper.

Coincidentally with a diminishing supply of the woods which form the basis of newsprint paper, there has been more than a normal increase of consumption of this class of paper, owing to a greater use of newspaper advertising on the part of merchants and manufacturers.

Although there has been a good deal of ill-informed speculation concerning possible new sources of paper making material, and many futile attempts have been made to utilize various reeds and grasses, waste paper, etc., the experiments of Brand, under the auspices of the United States Department of Agriculture in 1910, demonstrated the feasibility of converting cereal straws into a satisfactory paper pulp and commercial applications of the process or processes similar to it have already been made.

It is inevitable that paper manufacturers will turn eventually to sources of pulp other than timber, though for numerous kinds of paper trees will remain the preferred material. The use of cotton linters is a new and promising development. In the pulp and paper laboratories of the Forest Service at Madison, Wis., it has been proved experimentally that many western woods heretofore unused are well adapted for conversion into paper pulp by the processes ordinarily employed. Spruce can be replaced for pulp manufacture by twenty or more different woods, but the fact that it and trees similar to it take thirty-five or forty years to reach maturity is still a hindrance to their constant use. Timber trees cannot be treated as the agriculturist treats crop plants and be sown, cut and grown again as annual harvests, though some of the larger paper manufacturers have undertaken forestry work looking to the reproduction of wood on cut over areas. The West Virginia Pulp and Paper Company, in this country, and the Laurentide Company in Canada were pioneers in conducting operations for timber conservation and insuring future supplies of papermaking woods.

The solution of the problem is, however, to be looked for in another direction. For years there has been used in the manufacture of tough papers, bag and wrapping papers a fiber called Manila hemp, which is no hemp at all, but a species of banana belonging to the Scitamineae family the genus being Musa. Manila hemp is known to botanists as *Musa textilis* while the edible banana of commerce is *Musa sapientum*. The leaf stalks of the various species of banana are rich in cellulose membranes which give them first place as available sources of paper stock and it might be a profitable undertaking to plant the waste areas of the subtropical regions of our country lower Florida and California, with the wild banana or other fiber yielding plants not heretofore employed as raw material for paper making. They could be treated as annual crops to yield a steady supply.

An American company has been formed for the utilization of fiber extracted from the wild banana by a new method involving the use of a fiber-decorticating machine which separates the fibers mechanically and leaves them clean of incrusting material and ready for cooking in the pulp mill. The promoters of the enterprise are confident of developing within a few years a tropical industry capable of furnishing pulp and paper mills in the United States with a plentiful supply of papermaking material. Operations are now being conducted on a commercial scale in the Republic of Panama, near the Canal Zone.

Although reeds and grasses as raw materials for papermaking are of little importance at the present time, it may be said in favor of their use that the harvest is large and the plants are less subject to decay and rot in keeping than for example bamboo, banana and similar solid stalks which allow no ventilation in piling. Reeds and grasses are characterized by hollow cylinders which permit the passage of air and so obviate the decay resulting from the breaking down of vegetable matter which is more solidly massed in

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Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Gas Producer

To the Editor of the SCIENTIFIC AMERICAN:

Central stations in America operate a total of only 18,500 hp. in producer-gas engines, according to a recent estimate. This is a little under 10 per cent of the total of internal combustion engines in central power plants. The use of producer-gas in such places and in outlying plants should be much increased. Why is not more producer-gas used in America? In the SCIENTIFIC AMERICAN for Feb. 19, 1921, Ralph Howard discussed the shortage and waste of fuels, especially coal, and suggested the extended use of the gas producer or generator and internal combustion engine. He also stated that the practicability of this type of prime mover is not generally known, although it is constantly being improved. Mr. Howard gave a brief description of the apparatus and said that steam control, which is used to enrich the gas (carbon monoxide) has not been solved until recently.

It is rather a curious thing why, in this country where hundreds of thousands of tons of waste products, easily collected, are burned or dumped into the sea every year, manufacturers have not developed producer gas plants similar to those so successful in England and Europe. Considering the limitations of the petroleum supply, and the ever increasing consumption of crude oil and its distillates, the subject of producer-gas is very opportune. We have enormous reserves of coal, yet the efficiency in burning under boilers is very low. Up to 1913 there had been considerable investigation concerning the use of producer-gas. In that year the U. S. Bureau of Mines issued Bulletin 55 by R. H. Fernald, covering the subject fully. There were then 722 producer plants, 610 burning anthracite, 77 bituminous coal, 82 lignite, 1 wood and 2 oil. The advent of the oil engine practically stopped development of producer-gas units. It appears that this type of plant needed special fuels in order to reduce the labor charge. In fine, it failed to utilize low-grade fuels or waste products. The above mentioned installations were mostly in the northeast and north central states.

Australia, a country minus oil (so far) and little water power also had a development of producer-gas plants from 1904 to 1912, since then their use has gained considerably. The fuels so consumed are charcoal, coal, coke and wood. These include lignite and 6 ft. lengths of fire wood. At the Waihi gold mine in New Zealand, six 200 hp. engines used producer-gas, the cost of power being 6 pence (12 cents) per hp. day. British firms have advanced the operation of these plants, and now make producers and engines to work without trouble on such materials as charcoal, cocoanut shells, cocoa, coffee and rice husks, coke, cottonseed, corncobs, olive, sawmill and sugar cane refuse, peat and wood. In America there are enormous quantities of such available. Consider the almost criminal waste at our sawmills, cane sugar mills, flour mills the neglected peat beds of North Dakota, and the refuse of a hundred and one industries. All can be converted into gas in the producer and drive engines in central plants and other localities where power is needed. The Bureau of Mines has published a number of bulletins and technical papers on the subject, so engineers interested should secure copies. Foreign practice is also discussed. There is nothing complicated or mysterious about the suction gas (producer-gas) system, and its further utilization is desirable as a conservation measure and for cheaper power.

MAX VON BERNEWITZ
Brooklyn, N. Y.

An Appeal for Aid

To the Editor of the SCIENTIFIC AMERICAN:

I was approached some months ago by the present director of the Physical Laboratory at Bonn in behalf of his predecessor, the eminent physicist, Prof. H. Kayser. Professor Kayser has been recognized as the world's leading authority on laboratory spectroscopy and he is the author of the monumental work in six large volumes, published between 1900 and 1912. Upon his retirement last year at the statutory age for the University of Bonn, it proved to be impossible for him to live in any comfort on the depreciated pension allowed to him. It was therefore proposed that his remarkable library of books and pamphlets on spectroscopy should be sold so that the money could be used for his personal maintenance. The value of between $2,000 and $3,000 was placed upon this library. It seemed to me that it would be much more appropriate for friends and admirers of Professor Kayser or others having an interest in the University of Bonn who might be persuaded to buy the library and present it to the laboratory at Bonn with the understanding that it was always to be at the disposal of Professor Kayser during his lifetime.

Professor Kayser's nature and characteristics are such that no one could assign to him any of the qualities which have been justly condemned in many of his countrymen during the late war. On the occasion of the 250th anniversary of the Royal Society of London he was one of the delegates from Germany at the numerous meetings of the celebration, and in an after dinner speech at Cambridge his attitude was of a most friendly character to his hosts. Those were days in 1912 when tension was already beginning to be felt between Germany and England, and it may be recalled to the credit of some of the eminent physicists who were delegates from Germany that they brought as a testimonial of their regard for the Royal Society of London a special memorial tablet and address appropriate to the occasion. By one of the witnesses, at least this was regarded as an expression of solidarity on the part of the German educators with their English colleagues.

I very much wish that this library could be saved for Professor Kayser's use and its money value be devoted to his comfort.

EDWIN B. FROST
Yerkes Observatory,
Williams Bay, Wis.

An Old Catch Question in New Dress

To the Editor of the SCIENTIFIC AMERICAN:

Will you be kind enough to print the following question in your journal?

"A bird sitting on a perch in a cage is weighed together with the cage. How does this total weight compare with the weight of the same cage but with the bird flying in it? Why?"

Perhaps some of your readers will comment on this problem.

A. B. C.
Brooklyn, N. Y.

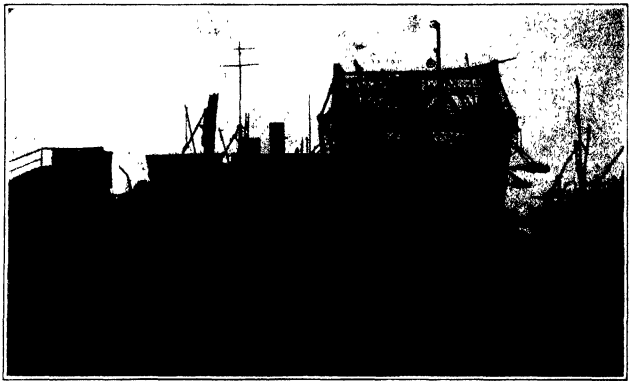
Sixty Tons Per Minute

Baltimore's New Coal Pier, and How It Makes Its Records

By J. F. Springer

WHAT is believed to be the greatest of all coal piers in respect to the rapidity with which coal may be delivered over the side to vessels is the new B. & O. Pier at Curtis Bay, Baltimore. The S.S. "Malden" was loaded at Curtis Bay with 7,222 tons of coal in 118 minutes. This is at the rate of 3,672 tons per hour or 61.2 tons per minute. We have here what *is undoubtedly a world's record for fast loading into* a single ship. At the same pier, on October 25, 1920, in the space of a 24-hour day, 910 cars, or 41,678 tons, were dumped over the side into various vessels. This is claimed as a second world's record for this pier, which is illustrated on the cover of this issue.

There is no doubt, then, that this new pier at Curtis Bay is a wonderful performer when it comes to handling coal over the side. The coal that comes to the pier *naturally arrives by rail from the mines in the* mountains far back to the west of Baltimore. A modern coal pier may receive more than it delivers over the side, and it may also deliver over the side more than it receives. The world's record as to the 24-hour period is not clouded, however, by any such fact that the pier received on October 25 less coal than it delivered. As a matter of fact, 49,630 tons were received, or nearly 7,000 tons more than were loaded on to vessels. The possibility of receiving and delivering different amounts is a consequence of the usual provisions for the storage of coal right on the pier itself. Such storage may be in bins or pockets located underneath the deck which carries the railroad tracks belonging to the pier. This is the method adopted in connection with the three tall piers at Hampton Roads, near Norfolk, Va. Or the storage may be provided for otherwise, as at the Curtis Bay pier. Along the Atlantic seaboard are numerous instances of coal piers on whose decks the regulation railroad coal car carries the coal. The three Hampton Roads piers mentioned and the present Baltimore pier are departures from this practice. Standard railroad cars do not go out on the pier. At Hampton Roads the coal is dumped from the standard car into special electrically operated pier cars and these go out on the pier. At Baltimore, this new pier is served neither by a railroad nor a pier car, but by special transporting devices.



General view of the new coal pier of the B. & O. at Baltimore, which puts coal into a single ship at a rate exceeding a ton per second

In all these piers, there are two problems. One relates to getting the coal out on the pier and alongside the ship, the other is concerned with transporting it transversely from the pier to the vessel. At Baltimore still another requirement was faced. This related to the matter of breakage. When coal is dumped by overturning the railroad car, whether on land prior to transportation on to the pier or on the deck of the pier itself, there is apt to be a good deal of breakage. Some may, perhaps, wonder why, at Baltimore, special efforts should be made to prevent breakage. Baltimore wished to engage in shipping coal to Europe. The European ovens belonging to steam boilers, especially in France, seem, frequently or usually, to be supplied with grates with bars wide apart, the intervals running up to something like 2 or 3 inches. It was desirable, accordingly, to have little or no fine coal in the mass when delivered finally to the factories. In short, if Baltimore was going to enter the foreign business and sell Pittsburgh and Maryland steam coal in such a market it had to prepare to get the coal from the railroad to the hold of the ship by a kind of personally conducted means of handling to prevent breakage.

Coal coming to the new pier is dumped by two modern car dumpers located a short distance from the land end of the pier. This coal will ordinarily come from a system of side tracks where loaded cars await their turns. The arrangements are such that a locomotive is not needed to take the loaded car to the dumper. *This movement is accomplished by gravity.* However, this gravity movement continues only to the neighborhood of the dumper, which is actually set at a higher elevation. Up the inclined approach a "barney" is operated by cable to push the loaded car. When the car has come to rest on the cradle of the dumper, it is overturned sideways and the coal dumped into a bin. From this, the coal passes to conveyor belts. These carry the coal out on to the pier deck. It may be delivered to loading towers. These devices are shifted along the pier deck on special tracks and may be halted at any points desired. This provides for stationing the towers exactly opposite the ship hatches. There are four such towers on the pier. There are subordinate conveyor belts mounted in shuttles in the loading towers. These belts run athwart the pier. Their function is to receive coal from the four main belts, which bring it out on the pier, and then make delivery to the sides of the pier. The pier is in fact so located and built as to be usable on either side. The shuttle belts belonging to the loading towers may be made to serve either side of the pier and thus serve ships on both sides.

The foregoing gives briefly the method used at first with this pier when it was being used to take coal from the dumpers and deliver it to ships. This method was, however, found to be something less than ideal, as it failed to put the coal into final position in the ship's hold. The coal had, in fact, to be shoveled back and trimmed by hand labor. It is safe to say that no such world's record as those given at the beginning of this article would have been possible if matters had been left thus. It was seen that some mechanical method was required, by means of which the coal could be put into final position, or at least, into approximately final position. The studies made of the residual problem have been highly successful, as is indicated by the records attained. Otherwise, this great pier 700 feet long, 111 feet wide, having a berthing capacity of four vessels, and costing upward of $2,500,000, would have failed of developing its full possibilities. While the transporting equipment insofar as it deals with the coal along and across the pier, would have been just about as capable as it is now, yet this capacity would have been, in part, useless. In loading ships, it is of no benefit to get the coal to or through the hatch faster than it can be taken away. The development of the new trimming apparatus has changed all this.

To explain this matter a little further, I may direct attention to the fact that where tall piers are used, as at Hampton Roads, where the three giants have decks some 70 or 90 feet above the water, gravity may be utilized to get the coal outboard from the pier. Thus, the coal is delivered by chutes, which may be more or less flexible, from pockets elevated above the tops of the hatches. The gravity action may be utilized to carry the coal to desired positions in the hold. At Baltimore the new pier is a departure from pretty much all American coal piers at tidewater, in that it is a very low structure, with the deck near the water level. Thus, the aid of gravity is pretty well abandoned at the start. To get the coal to its proper and final positions, mechanical effort must be brought in.

The new trimmers are four in number, one to each loading tower. They are suspended from booms, and the booms are set up on the tower superstructures. They are directly above the shuttle belts which receive coal from the main belts and convey it athwart the pier, as already described. When a trimmer is to be put into service, it is placed at the outboard end of the shuttle. The coal drops from the shuttle belt into a telescopic chute which delivers it to a curved steel plate. The plate delivers, in turn, to a rapid endless belt. This belt is a small one, but its rapidity of movement is very considerable, being 37½ feet per second. The coal is by this belt thrown to whatever nearby points are desired. The curvature of the steel plate which delivers to the rapid belt serves to prevent the coal from striking the belt with too much suddenness. It is said that the effect is to "cushion" the impact upon the belt and permit a steady stream to be delivered to the belt "without any breakage."

An operator is employed to control the trimming operation. He is provided with a cab at the bottom of the telescope chute and to one side of it. The apparatus may be shifted around through 360 degrees, so that all directions are within its scope. The rapid belt which does the trimming may be adjusted as to the angle at which it effects its throw. This enables the operator to control the distance. In order to get the greatest throw, the lip of the trimmer belt is elevated to its maximum height. As the need for shorter and shorter throws develops as the coal piles up at the distant points, the lip is more and more depressed. This change is made gradually, under ordinary circumstances. It has been found possible to throw coal a distance of 45 feet. The arrangements connecting the belt with the telescopic chute are such that the trimming belt may be dropped so as to be clear of the chute. This permits the chute to deliver directly to the pile in the hold.

The maximum reach of the trimmer belt from the side of the pier is 35 feet. It may be lowered to a maximum of 48 feet below the shuttle belt. The telescopic chute may be extended to a great length—as much, in fact, as 52½ feet. It may be shortened up to various lengths through a range of 21 feet. This leaves the minimum length 31½ feet. This variability of length permits serving various decks of the miscellaneous types of vessel which come to the pier. The

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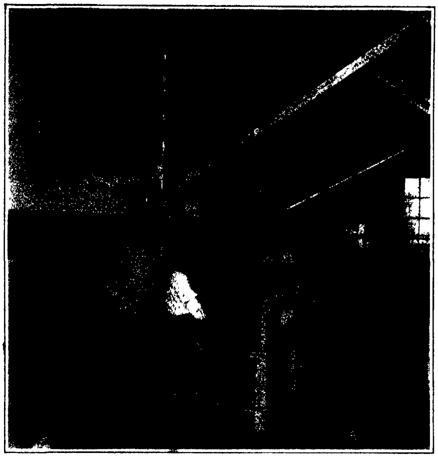
Valuable Binder Material from Waste

By George H. Dacy

AFTER 26 years of investigation and research, Mr. T. B. Mohler of San Francisco has discovered a process of renovating a valuable binding material from such waste products as city garbage, rice screenings, miscellaneous tailings and aftermaths. The range of uses to which the new material may be put is so wide that its appearance on the world market will affect many industries. Its efficiency and its extremely low cost of production are outstanding features of the new product.

The reclamation system which features the salvage of valuable adhesives from garbage and other refuse is relatively simple and does not involve the employment of special-purpose machinery nor the mobilization of costly and intricate equipment. Ordinary city garbage—rich in cellulose and animal matter—which has been accorded selection and examination to remove deleterious foreign material is reduced to a liquor form as a consequence of passage through automatic grinding machinery and subsequent exposition to centrifugal filtration. The dry cake or solid residue from these operations is used as a base for the manufacture of agricultural fertilizers. Although this cake is a by-product it is a valuable material which is so useful and of such intrinsic worth for farming uses, that the profits resulting from its reclamation alone would be adequate to justify the municipal collection of garbage and its reduction in order to obtain this fertilizing material.



Machine used in the laboratory for water-proofing fabrics with material recovered from wastes, and subsequently drying them on rolls by means of hot air from the furnace

The liquor which obtains from the filtration process, however, is the article upon which Mr. Mohler has been working so long. By a special method of fermentation, this liquor is converted into the desired binder. It can then be dehydrated and prepared for shipment in a crystalline form if the intention is to transport it long distances before utilizing it in the industries. On the other hand, if it is to be employed for manufacturing purposes directly in the plant where it is extracted, it can be used at once in the liquid form.

The fluid binder is a pure white liquid which will not discolor the most delicate fabric or cloth nor will it in any respect injure associated materials or coloring matter used in dying these fabrics. It is admirably adapted for the binding material to be used in the manufacture of coal briquets, the cost of the binder being but thirty cents per ton of fuel, as against current conditions of coal briquet manufacture, which feature the use of binding materials costing from $2.75 to $3 a ton. Laboratory, manufacturing-plant and private-home tests of briquets using the new binder demonstrate that they are clean, exude no disagreeable odors, can be handled readily without breakage, burn without fracture or disintegration to a clean, light ash and admit of the full derivation of the heating value of the fuel.

One of the interesting results attained by Mr. Mohler was the discovery that when his binder is combined with certain oils, it forms an emulsion which when applied to fabrics renders them waterproof and acid-proof. Again, this process like that of the coal briquet production is simple and inexpensive. Any material from the heaviest cotton to the finest silk can be treated in this manner without in any way changing its softness or flexibility of texture and without cracking or otherwise damaging the goods. The tendency of the treatment is to strengthen and increase the longevity of the materials. The cost of treatment ranges from two to eight cents a yard depending on the quality of the goods and the grade of the binder which is used.

It has been proved conclusively that the new binder is particularly adapted for the manufacture of raincoats, high grade mackintoshes, gossamers, oil clothing, sportsmen's coats, suiting, oil silk, dress shields, medical silk, wall decoration, tenting awning, ship decking, unbreakable oil cloth, imitation leather, linoleum, chemist's aprons and waterproof sacking. The processes involved are incredibly cheap and yet are productive of goods which surpass the others in durability and wearing qualities. A special feature of all these products is that they are non inflammable.

In all communities where rice mills are operated, the accumulation of rice hulls, by-products of the preparation of rice for commercial uses, is becoming a menace. These hulls cannot be burned nor carried out to sea and dumped. They can now be used for the manufacture of powerful and durable insulating materials which obtain from the proper mixture and processing of rice hulls, diatomaceous earth and the new binder. High quality wall board, box shook, toys, and unbreakable dolls may be made in this way. Powdered asbestos and silica mixed with the binder sticks to boilers and pipes so tenaciously that only a very heavy blow from a hammer will loosen it, and is not affected by either heat or cold. Superior, non inflammable water proof and acid-proof paper can be made by treating ordinary grades of paper with this material. This also applies to cartons and containers. One of the most unusual tests, which goes to show the great adhesive properties of this new material, is that it will bind powdered pumice, one of the most difficult substances known to hold together. Test blocks made in this way have, subsequently, been subjected to tremendous heat even up to fusing point without any evidence of fracture or injury.

Different kinds of building materials are made from the new binder combined with waste paper and straw. Boards of all sizes and dimensions can be made and, subsequently, can be sawed, planed, nailed and glued exactly like ordinary lumber. Sound proofing, heat insulating and refrigerator car insulation are made from straw, sawdust and waste paper, while wall board is manufactured from rice hulls and the binder, and other valuable articles are made from old leather and findings.

In order to obtain the base material for the extraction of the binder used in combination with the heavier and coarser fabrics and other materials a special garbage disposal system had to be provided. A method has been devised which admits of handling the city refuse in units of 50

(*Continued on page 480*)

Giant Crane Lifts Its Smaller Brother

THE Philadelphia Navy Yard boasts of the most powerful crane in existence. It can lift 350 tons at a distance of 115 feet out from its tower, and 50 tons on a reach of 190 feet. In its test for acceptance it lifted a maximum load of 400 tons. Its extreme height is 230 feet. The rotating part of the crane, with its maximum load, weighs 2,917 tons, and the total weight of the whole crane as it rests upon its pile foundations is 4,000 tons. A gigantic structure in very truth.

Recently there was constructed at the outer end of the pier on which the big crane stands a smaller crane of the traveling type. It was built at the outer end of the pier for convenience, and after completion it had to be moved past the big crane, so that it might operate on the shore end of the pier. How to make this transfer was the problem, until someone suggested that, since the yard possessed a crane of sufficient power and reach to lift the smaller crane bodily it would be a good plan to lift the little fellow up bodily, swing it around over the water, and place it again on the pier in the required position—which was done. We hear much in these days about relativity, and in the present case, although the lifted crane was small in comparison to its big brother, it weighed no less than 310 tons. Many of us can hark back to the day when a 310-ton crane would have been spoken of as "mammoth" or "giant."

The 4,000-ton crane at the Philadelphia Navy Yard lifting the 300-ton "pygmy"

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H E HOWE, Chemical Engineer

A Compilation of American Dye Patents in Abstract Form

THE Color Investigation Laboratory of the Bureau of Chemistry Department of Agriculture, announces that a compilation of American dye patents in abstract form is available for consultation by those who may care to call at the Laboratory and that information can also be secured by mail addressing the Laboratory and for the attention of Joseph Ambler, Acting Chemist in Charge Each patent has been abstracted under the following seven heads

1 Scientific names, when known or given in the patent

2 Intermediates used, with a very condensed statement of the method of manufacture

3 Class of dye, according to Schultz's eighteen chemical classes

4 Color of dye

5 Method of use

6 Fiber or material for which suitable

7 Name of owner, and, in parenthesis, name of patentee

The abstract has been placed upon 3 by 5 cards and a separate file has been set up for each of the seven headings These are completely cross indexed and the patents may be quickly located according to the interest of the investigators These abstracts do not do away with consulting the patents themselves but they do constitute what is probably the best index that has been devised for them and are sufficiently complete so that the user can decide at once whether the patent in question is one which he must consult or can eliminate from his consideration

Jute

IN the *Color Trade Journal* for April are a few paragraphs under "The Dyeing of Jute," which indicate the properties of the fiber as well as satisfactory methods for dyeing it

The jute is contained in the wood of the plant and is freed from the woody tissue by the retting process very much as linen is secured from flax It is longer and coarser than cotton and has great strength and durability when spun in a coarse yarn On account of these properties jute is largely used in the manufacture of carpets, in cheap portieres various types of covering, and rugs It absorbs dampness and retains it and, therefore deteriorates much quicker than many other vegetable fabrics Carpets with an under weave of jute should be kept in dry storage and if used where dampness prevails these carpets should be impregnated with alum which has proved quite successful in preserving the fiber Although a vegetable fiber jute has a marked affinity for dyestuffs When treated with chlorine and sodium nitrite a red color characteristic of tannin is produced This tannin like material in jute accounts for its absorption of basic colors in the same manner as mordanted cotton Jute in the carpet mills is ordinarily dyed with direct colors which are fairly fast Substantive colors dye jute without any addition to the dye bath Basic colors are dyed without previously mordanting the goods and where very bright red and blue are desired some acid dyes may be used.

Synthetic Resins

IN the April 13th issue of *Chemical and Metallurgical Engineering*, synthetic resins from furfural are discussed, this being a continuation of work at the Bureau of Chemistry growing out of an attempt to utilize corn cob products With the prospect of furfural becoming one of the chief organic chemicals research, looking to commercial uses of this material, has been undertaken and the work reported is a preliminary one on the possibility of preparing synthetic resins The experiments are described in some detail and the following general properties are given

"The resins do not have sharp fusion points, softening gradually till fluid The softening temperatures of the resins made as described lie between 25 and 100 deg Cent, but have not been carefully determined, since the softening point can be raised to almost any reasonable temperature desired by simply heating the resins at higher temperatures or for a longer period of time

"All of the above resins are practically insoluble in water They are somewhat soluble in turpentine, quite soluble in benzene, acetone and alcohol, and very soluble in furfural. The acetone, benzene and furfural solutions of these resins form varnish stains which, when applied to wood, give shades ranging from golden brown to black, depending upon the resin, the concentration of the solution and the number of coats applied The surfaces thus coated have a glossy appearance"

In all, eight resins have been produced for experimental purposes and when applied to white oak these give various shades of brown from the lightest when applied in a solution of benzene to one which is nearly black in a solution of furfural.

The Fineness of Calcined Gypsum

THE April *Journal of the American Ceramics Society* contains an article on the relation between fineness and other properties of calcined gypsum The experimental methods are described and the data indicate that a normal consistency is obtained with less water the coarser the gypsum and that the time of set is shortened with increased fineness of the material The finer the calcined gypsum the stronger is the set material until the degree of fineness goes beyond that of size 6 as defined in the specifications of the American Society for Testing Materials If the fineness is carried beyond this point there is a decrease in strength although the finer the calcined gypsum the more sand can be carried by it The authors state that their results are not based on a sufficient quantity of data to warrant the above conclusions being called more than indications and propose to continue their work

Sweet Potato Syrup

DR H C GORE of the Bureau of Chemistry, U S Department of Agriculture, has been experimenting for some time with sweet potatoes as a source of syrup, the intention being primarily to provide an economical outlet for the considerable portion of the crop that may not be marketable as well as to establish an industry which would assist in the diversification of agriculture in the Southern States The Department has now decided to establish a production unit or demonstration at Fitzgerald, Georgia, where questions of cost of commercial production as well as the market value of sweet potato syrup as compared with syrup from corn, cane malt, etc, can be determined Production is to be undertaken as soon as machinery can be installed and if this large scale experiment proves successful the commercial manufacture of sweet potato syrup may be undertaken Samples thus far produced are rich in sugar, highly palatable, and of a fine brown color It has been used with satisfaction for baking, general table purposes, and in the manufacture of candy

Research in Glass Containers

CONSIDERABLE progress is being made in the research laboratory established in Chicago to study the use of glass as a container in new fields of canning, preserving and bottling. The present problems have to do with determining the pressures which can be practically withstood, the best methods of sterilizing the materials canned in glass, precautions to be taken in packing to withstand transportation, and methods of improving glass containers so that they will withstand destructive agencies. The advantages of seeing the contents both during the period of processing and storing and at the time of sale very greatly offset any disadvantage that may be due to character of the container It has also been argued that a glass container makes it far more difficult for inferior materials to be used There are many problems still to be undertaken as soon as the organization has been completed and the work preliminary to the establishment of such a research laboratory completed.

Dyeing in an All Wool Suit

DR L J MATOS in *Drug and Chemical Market* gives the following interesting data with respect to the cost of dye in an all wool suit This is quoted here in the hope that it may convey more accurately information to those who seem afraid that American dye manufacturers because of higher costs in this country wish to establish an industry at a cost which will prove excessive to the users of fabrics.

"For each pound of cloth there will be required from 3 to 4 64 pounds of wool in the grease (average of 3.73 pounds) or 1 37 pounds on the scoured basis. Assuming that the average suit for a man will require 3¾ yards of 54-inch goods, this will weigh about 5.13 pounds or 82 08 ounces

"The amount of dye that is necessary to color this cloth properly will vary to a certain extent, but will be, for black, about 6 or 7 per cent or 6½ ounces of dye For navy blues the dye will be about 3½ per cent or 2 87 ounces, while for fancy shades, 3 per cent of dye will suffice, or 2 46 ounces

"Assuming the cost of black dye for wool at $1 35 the cost per ounce is 8.42 cents which gives an actual dye cost per suit of 48 4 cents The average cost of chrome blue is $3 03 per pound or 19 cents per ounce This gives the cost per suit of 54 53 cents while wool dyes for fancies average $1 25 per pound or 7 77 cents per ounce, giving a dye cost per suit of 19 11 cents

"From the foregoing it is obvious that the cost of dye per suit is one of the items of least cost, and might well be compared with the cost of the buttons generally used

"Nothing but the actual cost of the dye has been included in the above, and the cost of labor, steam and other chemicals has not been considered At a very liberal estimate, however, this would not amount to the cost of the dyestuffs used Even assuming that this would be the case, the total cost of dye and dyeing actually used on the cloth for a suit would only average 86 71 cents for all shades, from 'fancies' to 'blacks'"

Smoke Screens

HUGE clouds of black or white smoke employed to hide the movements of ships at sea and troops by land were evolved from small quantities of material according to information which is now published for the first time

Some of the secrets as revealed by Dr. George D Richter in an article in the current number of the *Journal of Industrial and Engineering Chemistry*, indicate that had the European War continued, the making of smoke screens would have become a fine art

The Chemical Warfare Service had a combustion chamber at the American University Experiment Station, Washington, D C, in which various smoke making mixtures were burned and density of the vapor studied by ascertaining how much it obscured the rays of electric lights placed in the midst of it Thus the various mixtures were measured according to their "T O P," which means "total obscuring power" in its full form

By permission of the Chemical Warfare Service, the formulae of the substance used in creating smoke screens is made public

The material which showed the most promise is known as the "B M" mixture because it was originated at the United States Bureau of Mines in a crude form, although it was perfected later by the Service

The proportions in the following representative formula were varied somewhat, depending on the method and the form of device in which the smoke was used.

	Parts
Zinc	35 4
Carbon tetrachloride	41 6
Sodium chlorate	9 3
Ammonium chloride	5 4
Magnesium carbonate	8 3

Testing Lubricating Oils

THE Agricultural and Mechanical College of Texas has started experiments in the chemical engineering and agricultural engineering departments to determine the properties of lubricating oils and to determine the qualities that suit them for use in various types of internal combustion engines Asphaltic and paraphinic base oils are the principal ones under consideration and several manufacturers have contributed samples of their products for the tests Automobile and tractor manufacturers have supplied different types of engines and it is proposed to subject the different oils in question to practical tests in these engines The physical and chemical qualities of the oils will be determined before and after test and an effort will be made to establish relations between the laboratory tests and a practical value of the oil as shown by the motor experiments

How Japanese Dwarf Trees Are Raised

THE little Japanese trees exhibited in the windows of the better grade Japanese novelty shops never fail to excite considerable interest, because they are so unusual. In fact, in Japanese horticulture the art of landscape gardening on a miniature scale plays an important, if not a leading rôle. A village or a single home, surrounded by beautiful country, will be formed within a plot of ground a few yards square by the Japanese artisans. A river with its bridges, a lake with tiny ships on its silvery surface, roads, gardens, fields—all these features are to be found in the more pretentious Japanese miniature works. Hence it is not surprising to learn that the Japanese, in order to carry out their miniature landscape gardening with the utmost realism and fidelity, have had to raise dwarf trees for this purpose.

So the custom of dwarf trees has become an established one in Japan, some of these trees attaining the age of 200 years. The whole system of culture of these tiny trees may be summed up as the reversal of nature's method. It really consists not in the survival of the fittest, but rather in the survival of the unfittest, so to speak. A poor, weak seed is usually chosen and planted. As soon as it has attained some growth, the leading shoot is trimmed off. The little plant then grows two other shoots, and these are carefully watched. When one shoot exhibits a strength that is vitally greater than its fellow, it is at once cut off and the weaker shoot left untouched in order to form the future dwarf tree's main stem or trunk. This system of trimming and cutting is followed punctiliously. Water is seldom used—only in such small quantities as to keep the little plant actually alive. The tree is kept in a pot too small for its full development and the roots are constantly pruned. The shoots are carefully trained and bent to follow the growth of a large tree.

All of which, it goes without saying, requires great patience, but this is a commodity with which the sons of Nippon are endowed to a degree approached by few of the Caucasian races, and the Japanese horticulturist never tires of watching the growth of his tiny trees. When such a tree has been growing for about five years, it can be left to take care of itself, since it has become accustomed through its training to follow the rigid course laid out for it, and can then be trusted not to strike out again in the pursuit of its natural size and vigor. In this manner magnificent specimens of dwarf trees are produced which compare favorably with anything found among their big brothers in the untrained forests of Japan.

All Photos Copyright, Keystone View Co

Chabo miniature trees and how they are trained to grow around rocks

Meteor Observers in Czecho-Slovakia

A CENTRAL office for collecting reports of meteor observations in Czecho-Slovakia was established in May, 1920, at Reichenberg, Bohemia, by Arthur Beer. A noteworthy feature of this undertaking is that fourteen branch stations have been established in different parts of the country for the purpose of gathering information regarding casual observations of meteors as distinguished from those made by regular observers.

Miniature Japanese trees of the Chabo variety, with their roots exposed

The Current Scientific American Monthly

THE June issue of the SCIENTIFIC AMERICAN MONTHLY will be found a valuable supplement to the last few numbers of the SCIENTIFIC AMERICAN. The number opens with an important contribution by Prof. Charles Lane Poor, who outlines a possible alternative to the Einstein Theories of Relativity that would save the Newtonian law. A discussion of this interesting paper appears on page 468. The article on the Roger Bacon Manuscript, which was published in last week's issue of the SCIENTIFIC AMERICAN, is supplemented by a more lengthy paper on this subject, outlining the history of the manuscript and efforts to decipher it, while an exceedingly interesting account of Egyptian life 4,000 years ago, describing the recent discoveries on the west bank at Thebes, supplements the article entitled "Looking Backward 4,000 Years," which appeared in our issue of May 7th.

"Visual Illusions in the Arts" is the title of an article by M. Luckiesh, which gives an account of tricks of lighting, color and form which are employed by painters, sculptors and architects.

Under the title "Chemical War on Disease," Dr. H. Schwarz gives a popular explanation of the action of certain chemicals on the toxins that are responsible for infectious diseases.

Prof. L. A. Hausman of Cornell University tells how the microscope may be used for the analysis of various foods. By this means it is possible to detect adulterants.

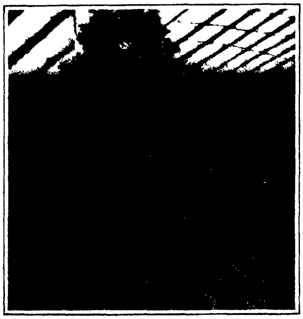
"Flavors, Odors and Infra-red Rays" is the title of an article describing the recent work of M. Charles Henry, who has discovered a relation between taste and odor and infra-red rays, and has thus been enabled to obtain perfumes which are far superior to ordinary ones, both in intensity and in delicacy.

An account of Jean Perrin's brilliant new theory to the effect that chemical energy is a direct result of the wave length of the various rays found in the visible and invisible spectrum, is written very lucidly and in a form that will appeal to the layman.

A special chair of experimental phonetics has just been established at the College de France for the distinguished priest, Abbé Jean Rousselot, who is now in his 75th year. M. Rousselot has been studying the production, perception and analysis of sounds all his life. An account of his work and the interesting apparatus he employs is published under the title "Experimental Phonetics."

One of the industries that suffered from lack of raw materials during the war was that of manufacturing

(Continued on page 480)



A Chabo tree about 100 years old

Pine dwarf tree. Note odd form of roots

Japanese garden, showing dwarf tree

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

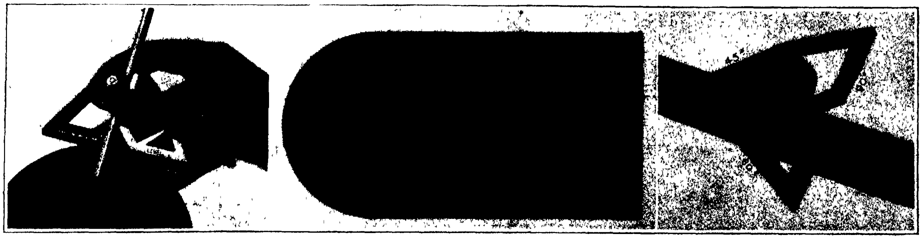
The line-carrying buoy that drives ashore before the wind with its cargo of rope being paid out

Blowing a Line Ashore from a Wreck

WRECKS on rocky shores, reasoned W. S. Crouch of New York, occur when the wind is on shore. He sought to take advantage of this fact in devising some means for getting a line from ship to land—the operation which usually *takes so much time and is so* fraught with peril. The line-carrying buoy which we illustrate is the result of his work. The buoy was recently tested at Rockaway Beach and did all that its inventor asked of it. Released from the ship, it blew steadily toward shore, the line unwinding behind it as it went, until finally it was dragged out of the surf with the line intact. In addition to its use in this manner, it is available for all the regular purposes of the ordinary buoy.

The Universal Angler

THE carpenter to a greater degree than any other mechanic is dependent upon squares, bevels, etc., but every mechanic has to use them a good deal. We illustrate herewith a little tool which is designed with the intention that it shall be all squares in one. It is got up so that all the ordinary angles, 30, 60, 45, 90 degrees, etc., can easily be located on it and it can be used with pencil, ruler, etc. It may be used as a scratch gage, a depth-gage, an inside square, a gage for transferring measurements, a plumb-gage, etc., with the utmost convenience. The pattern of lines and circles which we show was made with a single setting of the ruler in the gage. The tool is of aluminum, light and of handy size.



Left: The tool in use as a scratch-gage. *Center:* A pattern of angles and circles made with a single setting of the ruler in the gage. *Right:* The rule in position, showing how the various angles are obtained with one setting

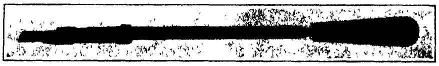
The handy angler that takes the place of a dozen squares and bevels

Tractor Hauls Wood Economically

AN excelsior manufacturer of Boston has a factory at Derby Junction in the wilds of Maine and the use of a small *track-laying* tractor made it possible for the plant to keep going at top speed during the roughest winter that wintry Maine has known. The tractor hauls a seven cord load of spool wood on two big sleighs from the woods to the factory, a distance of 7½ miles, twice a day, *no matter* what the weather conditions. Horses, when they were not held up by snow drifts, were able to make three trips in two days. The horses would make the journey to and from the lumber camp and then return to the lumber camp, remaining over night. The following day they would bring in a load and make another journey in each direction. In addition to coping with weather which would make the horses useless the tractor made four trips in the time the horses would make three, this extra load of seven cords being a big factor in speeding up production.

The Handy Hand-Scraper

RATHER well designed is the hand scraper which we illustrate herewith. The blades are of a quality not often met in scrapers, and will last as long as four ordinary hand-forged scraper blades. Nevertheless, admirable provision is made for replacing them when they do wear out, as will be seen in our picture. The clip is notched on the inside to receive the blade, and holds it positively in place, and the blade carries a lug on its rear end, which not alone prevents the blade from slipping back but which also causes the clip to tighten automatically when pressure is applied. The blades are supplied ready for use, so that no time is lost in forging them.



A hand scraper with renewable blade of special steel

A New Taper Pin Reamer

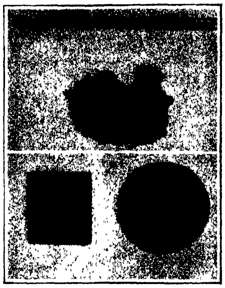
A TOOL designed for reaming holes for taper pins rapidly and accurately has been introduced by a Connecticut manufacturer. It is claimed that this new tool will ream holes in any metal at *least three times as fast as* a fluted reamer. It is designed to be used in a drill press as well as electric or air drill. For die making holes are drilled close together and by enlarging the holes with this reamer the metal between the holes can be rapidly removed. At one operation *an opening of any* desired shape may be cut out and proper clearance is provided.—By *Allen P. Child*

A Railroad Motor Car

A STANDARD motor car adapted for use on railroads by fitting special *trucks* is well suited for service as a private car, and could be used profitably on non-paying roads where the traffic does not call for the frequent service of heavy steam locomotives. A car of this kind has been built and patented by J. F. Kehrman, master mechanic of the Mississippi River & Bonne Terre Railway, at Bonne Terre, Mo. The general dimensions and features of the car are:

Cylinders, six, diameter 3¾ in. by 5 in. stroke. Total wheel-base, 10 ft. 8 in.; rigid, 3 ft. Swivel truck, 4 wheels, ball-bearing center plate, no arch brace, truck built with studs. Air pump attached to crankshaft, and air-brakes *on all* wheels. Equipped with whistle signal, horn, air sanders and air drums attached to running board, 2½ cu. ft. capacity. Also equipped with hand brake on front truck operated by steering wheel. Tires of open hearth steel flanges and taper—master mechanics' specifications. The car operates on 60 deg. curves, and is rated at 40 m.p.h.

The consumption of gasoline is about one gallon for 20 miles. In a trip of 63 miles over the Mississippi and Bonne Terre Railway, which *portion is on a* 1.8 grade with 10 to 12 deg. curves, the motor carrying seven passengers, three gallons of gasoline were used. Weather tops are being applied to the cars already in service which adds greatly to their appearance.



The new taper-pin reamer (top) the sort of work it will do (bottom) and the chips that it produces (center)

Recent Patent Decisions

Effective Anticipation.—The plaintiff in this case was the owner of letters patent relating to a method of delineating or reproducing pictures and designs, and seeks to enjoin an alleged infringement on the part of the defendants. The defendants set up three defenses—1, that the invention is without patentable novelty and is not the product of the inventive faculty in view of the prior state of the art. 2. That the subject matter of the patent was the conception of one only of the three inventors. 3. That the methods which the defendants employ in doing their work are not comprised by the patent as is shown by the file wrapper, and therefore there is no infringement.

Plaintiff's patent is for a process whereby multi-color pictures, having an embossed effect, are produced. The method of production is by use of a screen consisting of bolting cloth or other material through which coloring substances, such as paints and the like, are forced by pressure applied by means of a scraper, or what is termed as a squeegee, upon the background or surface upon which the picture is produced. An outline of the picture is first provided, according to the colors of which it is designed to be composed. The background or surface is given a base color which covers the whole of it, such as green, for instance. Such portions of the base color as are designed to be retained and form a shade in the picture are then traced out upon the screen, and blocked or stopped out, as it is termed, by the use of shellac or some substance that is impermeable by the paint or other coloring matter. The screen is then applied to the background, and the second color, such as blue, for instance, is pressed through the screen by the use of the squeegee upon the background—the second color overlaying the first, except such of the first as has been blocked out on the screen The blocking-out process and the application of colors are repeated in the same way until all the colors of the design are produced upon the picture. The result is that each subsequent color overlays some portion of the previous colors, so that the last color applied always overlays in some area all the previous colors. Thus is produced a picture having an embossed effect, very attractive to the vision, especially when oil paints are used of such viscous consistency as to give such sensible thickness to the succeeding layers as to form plateaus of color. The screen, being stretched upon a frame, is so hinged upon or adjusted to another frame as to give exact register in outline of colors, as well as exact register of the weave of the screen's fabric, upon each succeeding imprint.

The court found that the plaintiff's patent was not anticipated and was valid The point of law adduced is that, to be effective as an anticipation, a patent must be so clear and definite as to enable any mechanic skilled in the art to reach the patented invention certainly, directly, and without the necessity of experiment—and this rule is enforced with particular strictness when applied to a foreign patent Where infringement is charged, the burden of proof is cast upon the defendant to establish anticipation beyond a reasonable doubt—*Selectasine Patents Co v. Prest-O-Graph Co. 267 Fed., 840*.

The Police Fort

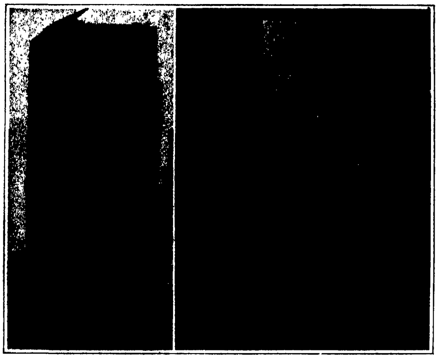
PERHAPS the newspapers exaggerate when they employ the expression "crime wave." Perhaps there are no more bold crimes of violence today than there were twenty years ago, the different impression that we get being due merely to greater publicity. Or perhaps, taking a less extreme view, the difference is due merely to the superior operating facilities which the automobile and other modern inventions have given the criminal.

A glance at the accompanying photographs, showing the latest aid to the enforcement of law and order by the Chicago police, ought however to be sufficient to make the most skeptical person realize that we are "confronted by a condition, not a theory." It seems that the Chicago cop is at such a disadvantage in his efforts to cope with the highway man along conventional lines that it has been necessary to furnish him with a portable fort. This consists of a screen of bullet-proof steel, some ten feet high and four feet wide. It is made up of two panels, two feet each, firmly hinged to one another Mobility is attained by the simple expedient of attaching casters—casters just like those under the dining room table, only more so. This miniature block house can be used by a single guardian of the peace, or by two—though in the latter event it seems that it will provide somewhat crowded quarters.

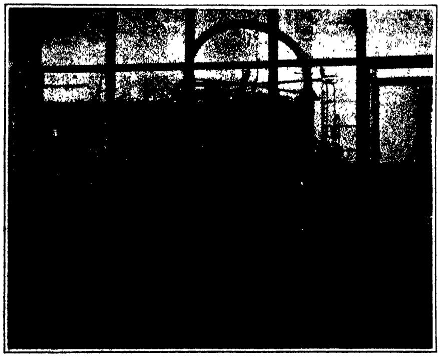
Saving the Pedestrian

NUMEROUS inventors have put forward safety fenders for automobiles, designed to catch up the unwary pedestrian who gets in the path of destruction, and prevent him from being thrown under the wheels of the car. Numerous of these inventions were entirely satisfactory so far as their mere working was concerned, but they have almost without exception been open to the fatal objection that a car equipped with one of them would look like a cross between a folding bed and a portable concrete mixer In the eye of every motorist it is the other fellow who is the reckless driver, and who is responsible for whatever of disrepute the man at the wheel suffers And no motorist is willingly going to attach to the front of his car any device that disfigures it to the extent that it would be disfigured by the huge sweepers, nets and swinging arms that have featured most of the pedestrian-saving apparatus that we have seen

The safety fender that does not mar the lines of the car yet picks up the pedestrian who gets in the way of the automobile



The portable block-house adopted by the police of Chicago, as used by a single officer and by two



The carburetor testing plant of the Bureau of Standards, which determines the proper atmospheric pressure for a carburetor as well as the best temperature

We must however, recognize the device pictured on this page as decidedly different from the usual run of safety fenders Every car carries a fender, to begin with, argues Mr E Finelli of New York, the inventor, and if a safety device could be incorporated in the fender in such a way as to violate in no way the lines of this attachment, there would be no objection to its use The photograph indicates the extent to which he has succeeded in making his safety fender architecturally a part of the car In the demonstration which our photographer has caught, the inventor himself played the part of "victim" and so great was his confidence in his fender that he allowed himself to be struck by a car moving at 25 miles per hour Except for the shaking up natural in such a collision, he escaped without the slightest damage

The fender can be attached to any make of car It weighs but 75 pounds

Have You the Right Mixture?

A SPECIAL carburetor test plant, developed by the National Bureau of Standards under the exigencies of war, is applicable in determining the efficiency of air craft apparatus in times of peace So if your carburetor acts strangely and refuses to yield to customary treatment, bundle the unruly mechanism and address it to the Bureau of Standards, Washington, D C

It may be that the aviator is unable to determine accurately the ratio of air to fuel under various service conditions That is one of the chief functions of this Government experimental plant The plant was designed for handy, speedy and definite observations relating to carburetor performance, without including the complications incident to engine behavior in such testing

The machinery for testing the carburetors is comprised of something made like a mouth or opening air meter, supplying air to small altitude chamber, in which the carburetor is mounted Air is forced through the carburetor by a vacuum pump, the flow pulsations in the air stream being simulated by an apparatus controlling both rate and amplitude of the pulsations

Pressure within the carburetor chamber can be lowered from that of the atmosphere to about one quarter of an atmosphere, moreover, the air temperature can be raised to any desired value above that of the atmosphere Perhaps your carburetor is operating at a tremendous loss of motion—then, this test plant can indicate methods whereby maximum convenience and a minimum of cost and lost motion are possible

Experiments in this aeronautic power plant have proved the capacity of the Bureau of Standards for reproducing substantially any condition which may obtain in service on an engine; and yet variables due to the engine condition are eliminated Weighing of the fuel, observations of pressures about a carburetor which permit of determining the mixture ratios, and the coefficients of flow under any air-craft service conditions—these are the functions of the test plant, operated by one man

Recently Patented Inventions

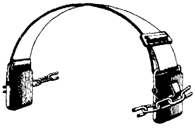
Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Electrical Devices

SEPARATOR FOR STORAGE BATTERIES—W Best, 404 E 10th St, Kansas City, Mo An object of the invention is to provide a separator of slate, located between the plates of the storage battery which will be acid proof and a perfect insulator which will withstand enormous heat without deterioration and which will last indefinitely with ordinary care

Of Interest to Farmers

BACKBAND—J B McHugh, P O Box 16 Zachary, La Among the objects of the invention is to provide a backband for draft animals which will be comfortable to wear and which will be readily adjustable to animals of different sizes A further object is to provide means for securing the trace chains to the backband and to provide a backband which will be strong and durable


A PERSPECTIVE VIEW OF BACKBAND WITH TRACE CHAINS CONNECTED

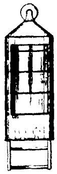
MOUNT FOR PLOWS AND OTHER TOOLS—E Dunlap, Diamond Springs, Cal The invention has for its object to provide a gang plow supported on one wheel which may be turned or swung around relatively to the tractor or draft member This connection of the plow with the draft member makes it possible for the plow to be turned around among trees and it is also possible when the plow shares are suspended to back the plow into corners In this way the plow may be operated anywhere the tractor may go, on very small lots as well as large fields

AUTOMATIC RELEASE—E D Pepper, Pickens, Miss An object of the invention is to provide a device which is especially adapted for use with plows, and so constructed that when the plow strikes an immovable obstruction in the ground the draft means will be automatically unhitched from the plow The device may be used either with horse or tractor drawn plows

Of General Interest

FILING DEVICE—A C. Barnard and W O Banks, Oakland, Cal This invention relates primarily to filing devices and the like which are generally used in office equipment and has reference more particularly to a device for conveniently filing documents or data such as railroad or steamship freight and passenger tariff publications, which require considerable handling The equipment can be manufactured and sold at a comparatively modest cost

POPCORN HOLDER AND DISPLAY CABINET—F R Giddings Crosby Wyo The primary object of the invention is the provision of a display device, and more particularly to a display device in the nature of a popcorn tank by which the popcorn may be maintained in crisp and desirable condition and at the same time attractively displayed for selling purposes the invention will effectively perform the functions above stated and will obviate the necessity of attention


A FRONT ELEVATION OF THE DEVICE

ATTACHMENT FOR CYCLORAMIC SCENERY BATTERIES—R C Scheurer and F. G. Greenberg, address R C Scheurer, 508 Summit Ave, West Hoboken, N. J This invention relates to theatrical scenery The general object is to provide an attachment that may be applied to the back batten and side battens in such manner that when the battens with the scene attached are being raised and lowered to and from the flies, the side battens will hang pendent in the same general vertical plane as the back batten, whereby to clear adjacent scenic elements and other objects

STREET CLEANING DEVICE—F M Grady, 520 Dakota St, Butte, Mont. The aim of this invention is to provide a street cleaning device to effect a deliverance of snow or other material cleared from the sidewalk or street by the device from one side of the device toward the curb The angle of the scoop or implement may be varied with respect to the handle by a simple manipulation of the parts

CALENDAR—J A Chrysander, 201 W 109th St, New York, N Y Among the objects of this invention is to provide a device in the nature of a calendar, but which is not limited to this adaptation and in which a plurality of memorandum spaces are provided, the leaves forming these memorandum spaces being capable of being disposed in such a manner that it is unnecessary to sever them from the pad of the calendar so that a permanent record may be kept

MAGAZINE FOR HAND FIREARMS—W E Roskrush, c/o City Club, Spokane, Wash The object of this invention is to provide a magazine arranged to insure a proper delivery of the uppermost cartridge into the barrel without danger of scraping, scarring or otherwise injuring the leader bullets Another object is to prevent slippage or accidental forward movement of any one of the cartridges except the top cartridge, and to prevent the upward tilting of the under cartridges and scarring of the bullets

BABY CARRIAGE—G H Smith, 23 Berkely Ave Newport, R I An object of the invention is to provide a construction which the two members against relative movement of the carriage as it moves, and at the same time provide a construction which allows the rocking mechanism to be thrown out of operative engagement with the body, so that the carriage may be moved without imparting movement to the body

ROLLER SCREEN—J Mugno, Jr, 18 Bergen St, Brooklyn, N Y It is the primary object of this invention to so construct a rolling window screen that the cross bar thereof will remain in the position in which it is released and without sagging It is a further object to so construct a screen of this character that the roll is at all times under sufficient tension to cause the screen to stretch and be perfectly flat

BABY ENVELOPS—Selina Backmann, 428 99th St, Brooklyn, N Y This invention relates to infants' wrappings, and has for an object to provide a wrapping which may be placed around a child when carrying it from one place to another A further object is to provide a wrapping of the class indicated which will keep the infant warm in the coldest of weather

MOVABLE CAGE—W W Ray, c/o Eastern State Hospital, Lexington, Ky The invention more particularly relates to a squirrel or mouse cage which is propelled by the occupant and caused to move in a well defined path, an object being to provide a cage of this character which can be used as a means for advertising by placing the same in a store window or other public place

STUDENT'S NON-ELECTRIC TELEGRAPH KEY—D G White, 460 5th Ave, New York, N Y This invention relates to a learner's telegraph key, and has for an object to provide a construction which will give a double sound on the order of a regular key while at the same time presenting a simple construction which will give the proper motion and position to the fingers and in fact to the entire hand without the necessity of using an electric current

LIQUID DISPENSING APPARATUS—I Lowy, 1317 Fletcher St, Chicago, Ill An object of the invention is to provide a device by means of which a liquid, such as a syrup or similar liquid, may be readily discharged from a glass bottle in a convenient and sanitary manner by the simple pressure of the finger against a releasing valve, means being provided for holding the dispensing mechanism in the neck of the bottle and rendering the bottle air tight

SILVER SOLDER—W Bocchetti, 259 8th St, Brooklyn N Y. This invention relates to a composition for use in the soldering of silver, and has for an object the provision of a solder with a low melting point which can be used at a temperature which will not melt silver, thus avoiding warping and distortion. The composition is composed of silver 59 5%, copper 25 5%, zinc 15 0% and one gram of arsenic trioxid to each ounce of above

EGG CARTON—J M Yarnall, 100 McLean Ave, Yonkers, N Y The object of this invention is to provide a construction for holding eggs in position and at the same time providing a limited amount of protection Another object is to provide a device formed of two parts hinged together with means in each part for receiving eggs so that when the parts are hinged together there will be a double row of eggs held out of contact but within a minimum space

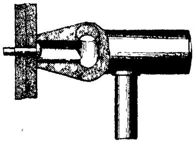
PRINTERS' QUOIN—G Duncanson, Jr, 94 Randolph Ave Jersey City, N J Among the primary objects of the invention is to so construct a printers' quoin that the two members constituting the quoin will be positively guided in their movements relatively to each other, and to provide means for maintaining the two members against relative movement when they have been set in operative position The device is capable of use with chases or frames or ordinary construction

HYDRAULIC SHIP'S ARMOR—P J Van Poelvoorde, 93A Barbarossa St Nymegen, Holland The principal object of the invention is to provide a ship's construction including an effective armor against the explosive action of torpedoes and mines A further and more specific object is the provision of a protective construction which will embody the presence of a water mass maintained between inner and outer walls whose relation is such that an explosion against the outer wall will have its destructive effect dissipated in this water mass

ADVERTISING AND OTHER DEVICES—H K Harris 96 Victoria St, Westminster, London, England This invention refers to devices provided with a selective part or a series of such parts adapted to be brought into successive position in order to control the movement of exhibiting means in the case of advertising devices and of analogous parts which have to be set into predeterminable positions in the case of other devices

Hardware and Tools

TOOL—B F Baird, 323½ Allegheny St, Hollidaysburg, Pa The invention particularly relates to a tool designed for use in connection with the removal of rivets, an object being to provide a tool which supports the plate or plates, on which the rivet is positioned, so as to prevent bending or bulging of said plates during the operation of removing the rivet, the device receiving the removed rivets and permitting the latter to fall to the floor without endangering persons


A VIEW IN OPERATIVE POSITION

LOCK—A. Lasky, 110 Williston St, Bridgeport, Conn. The object of this invention is to provide a lock more especially designed for use on trunks and similar articles and arranged to prevent picking of the lock and opening the trunk by unauthorized persons A further object is to provide a lock which is simple and durable, and therefore not liable to get easily out of order

ADJUSTABLE CASTER—C. W Ostrander, 147 Pratt St, Winsted, Conn. This invention has for its object to provide a construction wherein the usual caster effect is secured while the wheel thereof may be raised and lowered and lockd in any adjusted position. Another object is to provide a vertically adjustable wheel for casters wherein means are provided which will permit the vertical adjustment substantially, regardless of the weight thereon

SCREWDRIVER.—J Peyer, 301 W. 68th St., Brooklyn, N Y. This invention relates more particularly to a type of tool having a handle separable from the tool proper, in order to adapt the tool to the particular work at hand by reinstating within the handle a smaller or a larger driving shank or bit, chisel, punch, or various other kinds of tools.

Heating and Lighting

OIL BURNER—K D Obenshain, 400 Heard St, McKinney, Texas The invention has for its object to provide an economical and easily handled burner of the character specified, having a large capacity and wherein the burner is automatically controlled by the differential pressure between the oil and steam within the burner head

Machines and Mechanical Devices

INKING ROLLER—A R Colgin, 916 Napier Ave, Richmond Hill, L I, N Y The invention relates to printing presses, its object is to provide an inking roller arranged to reduce the amount of pastic composition to a minimum Another object is to permit of retaining the comparatively heavy spindle or stock by the printer while the lighter shell is shipped to the roller maker for replacing a worn out or defective rim by a new one, thereby saving considerable in the expense of shipping

ATTACHMENT FOR HAT CLIPPING MACHINES—J S Leibowitz, 133 Clymer St, Brooklyn, N Y The principal object of the invention is to provide a pneumatic means in the nature of an attachment which is adapted to be associated with hat clipping machines for effecting the removal and collection of clippings therefrom, the device is in the nature of a hood having an exhaust nozzle designed to communicate with a suction hose, and is adapted to be attached to the machine without materially altering its structure

THERAPEUTIC APPARATUS—J J Carlotti, 80 Perry St, New York, N. Y Among the objects of this invention are to mechanically induce circulation of the blood in the human body, to mechanically manipulate the human body, to avoid shock or injury to the body when treating the same, to regulate the extent and quality of the treatment, and to insure similarity in the treatment administered

RATCHET CHAIN BLOCK—W R. Butner, Yerington, Nev An object of this invention is to provide a ratchet chain block having one side thereof anchored and the movable chain operatively connected to the other side of the block, and caused to move by the oscillation of the lever imparting rotary movement to a chain sprocket wheel, and provide means for controlling the ratchet engagement of the lever with the ratchet wheels, and for preventing the chain from entangling the sprocket wheel The device can be folded into comparatively small space when not in use

Prime Movers and Their Accessories

ELECTRICAL VAPORIZER AND BURNER—N D Belinski, 6138 Callowhill St, Philadelphia Pa The invention relates to internal combustion engines, and its object is to provide an electrical vaporizer and burner arranged to convert liquid fuel into a superheated burning vapor at the time of its passage into the working chamber of an engine cylinder Another object is to render the engine self-starting

Railways and Their Accessories

DUPLEX BOILER GAGE—C H and W R Johnson, 477 Palisade Ave, Jersey City, N J The object of the invention is to provide a boiler gage for use on stationary or locomotive boilers and arranged to remain in service even in case one of the glasses should break Another object is to allow convenient replacing of a broken glass without interrupting the use of the gage

ROLLER BEARING CAR WHEEL—W. B. Bridges, 210 East Broad, Texarkana, Ark. The object of this invention is to provide a roller bearing car wheel which is simple and durable

(*Continued on page 478*)

The Yangtse Shallow-Draft Steamer "Anning"

(*Continued from page 461*)

a hinged flap. In Fig. 2, the vessel is at shallow draft and the flap automatically takes up the best possible position for efficiency. In Fig 3 the flap is shown with the vessel at deeper draft. In this case the flap has gone up to the top of the tunnel and the propeller efficiency is secured by taking full advantage of the increased draft of water.

A large number of vessels have been fitted with this system, including 16 small gunboats 120 feet long by 20 feet beam for the "Tigris," and 12 large gunboats 230 feet long by 36 feet beam for the "Tigris," "Danube," etc.

In navigating such rivers as the Yangtse between Ichang and Chungking the tunnel system steamer has a further advantage over the ordinary type of screw steamer, for when passing through rapids where there is broken water the propeller in the tunnel is not nearly so liable to be affected by the disturbances This has been proved by experience gained with the "Shu-Hun," a predecessor of the "Anning," which has been run on the Yangtse since 1913 and is to this day recognized as the best steamer on that reach of the river.

Owing to the civil war along the banks of the Yangtse, in which north and south China have been engaged, a certain amount of interruption of the steamer navigation has taken place, more particularly where Chinese vessels were concerned It is understood that conditions have somewhat improved in this respect recently, and it is expected that there will be great developments in the shipping on this reach of the river There is no doubt but that many vessels similar to the "Anning" could be most profitably employed there

Putting Motion Into Mechanical Drawings

(*Continued from page 464*)

job involves special apparatus in the shape of an "animating stand" The animating stand consists, first, of an angle-iron framework in the lower part of which is a broad table, at convenient working height, upon which the drawing—called a "mechanigraph" now that it is finished—is placed The camera is carried overhead, with its lens pointing down toward the table, and is mounted on slides so that it can be moved up or down to permit covering any size of field.

The motion picture camera has two shafts for operating its shutter and film-moving mechanism When the shaft ordiarily used is rotated, each rotation causes eight exposures to be made The second shaft causes one exposure to be made at each revolution, and is known as the "stop-motion" shaft This is the shaft used in making mechanigraphs Instead, however, of being driven by hand through a crank, it is driven by a small electric motor In photographing a job the motor is allowed to run continuously It does not turn the shutter shaft however, unless a trip is operated by hand or by foot When the trip is operated a positive clutch engages the shutter shaft, gives it one turn and makes one exposure, and then automatically disengages, the motor running idle until the trip is again operated Needless to say the clutch is so adjusted that when idle the shutter is closed

The mechanigraph is placed on the table and adjusted as to position so that it is in proper relation to the field of the lens, the camera's height is adjusted so that all or as much as may be desired of the drawing is in the field, the lens is focused, the stop or opening set, and the camera loaded with film and closed With everything ready for work the lights are turned on. These are mercury-vapor lamps suspended adjustably on each side of the table, so that the field is brilliantly and evenly illuminated by the greenish glow.

In the case of the vacuum fuel-feed system, the picture is started by showing the exterior of the apparatus There is no motion to be registered, so the trip is held in the operating position and the camera shaft is turned continuously until a sufficient length of film has been exposed. Then the exterior parts are "dissolved out" The most effective way of doing this is to use a "cross dissolve" By pressing a button on the camera a mechanism is engaged which gradually closes the shutter while the motor rotates the camera shaft The result is that the light admitted through the lens is decreased slightly in each successive exposure until finally the shutter is completely closed and no light enters If this film were developed the result would be a gradual fading of the picture until it would disappear completely

At this point the drawings representing exteriors, which have been temporarily laid over the sectional drawings, are removed, bringing the working parts into view Then with the shutter closed the film is run back to the exact point where the "fade" was commenced The motor is then run forward and the fade is repeated, going over the same film as before—with one important difference Where the shutter, on the "fade-out" began to close it now begins to open, and when the point is reached where the shutter was completely closed on the fade-out, it is wide open on the fade-in This is called a "cross dissolve" or an "overlap dissolve" On the screen, the result is that the exterior view dissolves there is not a better word—into the interior

A few feet of film are then run through showing the working parts stationary, after which the real work of the "animator" begins The parts must be photographed in such a way as to show their movement They cannot, however, be moved and photographed while they are moving, as in the familiar process of "straight" motion picture work The parts are moved by hand a small fraction of an inch Then the trip is operated and the motor causes the camera to make a single exposure In motion picture parlance, one "frame" is exposed Then the parts are moved another fraction of an inch and another exposure is made and so on—a little movement and one exposure, another movement and another exposure, still another and another until the parts have completed a movement, or a series of movements All movements must be equal when a steady motion is required otherwise there will be a jump on the screen. In the case of the subject in question the movements were each about a thirty second of an inch

A curious feature of this work is that it is not really motion picture photography at all It is simply a series of "still" photographs showing a succession of different positions of the object photographed. On the screen, however the illusion of movement is perfect Even if the animator, through an error of judgment, moves the parts too far at each exposure, the projected picture still maintains the illusion of motion rather than a succession of "stills," but the motion will be a series of very rapid jerks or jumps

One of the difficulties of mechanical animation becomes evident when there are several parts to be moved and it is impracticable so to connect them that they will move together They must be moved separately, and the movements must be so gaged that the proper relative positions will always exist. Usually this involves a schedule, prepared after all the movements have been exactly calculated and tabulated.

There is a good deal more to be done, however, before the work is finished The object sought is not merely to show how

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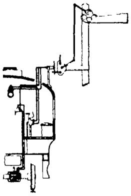
RECENTLY PATENTED INVENTIONS

(*Continued from page 476*)

in construction, composed of comparatively few parts and arranged to permit of easily making repairs without requiring removal of the axle from the car This invention permits the use of a stationary axle or similar support, hence axle journals and bearings as now generally constructed may be dispensed with

AUTOMATIC TRAIN CONTROL — E H CHABOT, 23 Temple St, Nashua, N H This invention relates to means for automatically stopping trains if for any reason the engineer fails to observe the signals which are set against him The device has for its object to provide simple and effective means whereby it is impossible for a train to pass a signal that is set to stop or caution position without having the controlling mechanism operate to shut off the steam or apply the air brake, or both, to bring the train to a stop



A DIAGRAMMATIC VIEW SHOWING THE SIGNAL MECHANISM

Pertaining to Recreation

TOY —E C RICHARDSON, 8 Pershing Court, Ridgefield Park, N J Among the objects of the invention is to provide a toy of the nature of what is commonly known as a "see-saw" A further object is the construction of a certain operating provision by means of which the see-saw may be moved and which will further serve as a grip whereby the children may grasp the see saw so that danger of their falling off is reduced to a minimum

Pertaining to Vehicles

VEHICLE WHEEL —M BENZ, Box 2, South Chicago, Ill An object of the invention is to provide a vehicle wheel having means in itself for absorbing and dissipating the shocks and jars. A further object is the provision of a device in which a solid tire is engaged by a pair of outer rim members and a pneumatic tube is arranged between the solid tire and the hub, thereby safe-guarding the pneumatic tube from puncture without lessening the resiliency of the wheel

DEVICE FOR CONTROLLING FROM A DISTANCE THE WINDOWS OF MOTOR CARS AND OTHER VEHICLES —P SEURIN, 84 Rue Lauriston, Paris, France This invention relates to an air pressure device for controlling or operating from a distance the windows or glass panes of doors, front frames and partitions of motor cars, which device can be used for controlling the movable windows of vehicles such as motor buses, railway cars and the like

GAS ENGINE CUT-OUT MUFFLER —H M WRIGHT, JR, 144 W Newell Ave, Rutherford N J. An object of the invention is to provide a gas engine cut out fitted with a double cut out means such as a motorcycle or automobile engine cut-out and muffler which may readily be attached to a motorcycle or other internal combustion motor vehicle and which may be installed to replace the ordinary type of muffler usually employed

TRUCK —F E CARTER, Box 165, Yuma, Colo The invention relates more particularly to a truck for handling the wheels of heavy motor vehicles. The object is to provide a truck which may be easily positioned to receive the wheel, and which may be adjusted to accommodate various size wheels, and may be positively set or locked in engagement with the wheel to thereby support and carry the same

ANTISKID DEVICE.—J R BAUDE, 2705 Jackson Blvd, Chicago, Ill Among the objects of the invention is to provide a form of antiskid device that can be quickly attached to the rim of a wheel whereby skidding forwardly, backwardly and laterally will be prevented A further object is to provide such a device as can be attached or detached without the use of any tools, the device takes up little room in transportation

PNEUMATIC JACK AND PUMP.—C. STEPHENS, Rosendale, Mo. The particular object of the invention is to provide a device adapted for use with automobiles Another object is to provide a device in which the pump may be used to supply fluid pressure to the jack or by a single manipulation may be adapted for use as a pump for inflating a tire or for general purposes.

TIRE CASING —C W MIEGEL, 828 Lambeck Ave, Jersey City, N J This invention has for its object to provide a casing especially adapted to be proof against blow-outs, rim cuts, and side wall breaks, and to add resiliency to the tire In case of a puncture of the outer portion of this tire the inner portion will immediately reinforce the outer portion

LENS FOR HEADLIGHTS — L and H BENZER, 141 Roebling St, Brooklyn, N. Y The invention relates to lenses for projectors, and it pertains more particularly to lenses adapted for use in connection with headlights of motor vehicles It is the primary object to increase the intensity of the side or "ditch lights," this result being obtained by the transversely concave surfaces of the lens

WHEEL —G YATES, 3215 Carnegie Ave, Cleveland, Ohio This invention has for its object to provide a wheel construction wherein roller bearings are arranged between the wheels and the journal box, the wheels being rigidly connected With this construction the housing ring may be removed, and the rollers also removed without taking the wheel off the axle

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NEW BOOKS, ETC.

EMINENT CHEMISTS OF OUR TIME By Benjamin Harrow, Ph D New York D Van Nostrand Company, 1920. 8vo, 248 pp, 21 illustrations.

As Dr Harrow says the pioneers in chemistry have inspired a few biographers, but our modern chemists are largely ignored by permanent literature Hence this popular volume of life stories dealing with Perkin and his coal tar dyes, Mendeléef and the periodic law, Remsen and the rise of chemistry in America, and eight other eminent moderns whose claim to attention is indisputable The high lights of their careers are picked out with precision, their discoveries are carried forward into present day development and practice in a most interesting way, and a rich gallery of portraits enables us to meet these notables, as it were, face to face

PELOUBET'S SELECT NOTES ON THE INTERNATIONAL UNIFORM SUNDAY SCHOOL LESSONS FOR 1921 By F N Peloubet and Amos R Wells Boston: W. A Wilde Company 8vo, illustrated

Each year more and more Bible students recognize the inspiration and almost indispensable help to be derived from this commentary, with its suggestions to teachers, its judicious treatment of doctrinal questions, its fresh view points and its maps and illustrations Its selection and arrangement of material and the manner in which it spurs and sustains the interest speak volumes for the ability of the compilers

PATENT LAW By John Barker Waite Princeton, N J: Princeton University Press, 1920 8vo; 316 pp

Professional men and men of business often find it necessary to ascertain their rights in respect to inventions and patents. Professor Waite's new text book covers the substantive law of patents, their nature, validity and effect, and their characteristics as property He has canvassed every issue passed upon by the courts, and his work discloses a close-knit structure of facts and interpretations that the layman, as distinguished from the patent practitioner, will find exceedingly helpful.

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the parts move, but rather to create a picture showing the effects caused by these movements as well In the present instance this involves showing the flow of gasoline from the main tank to the vacuum tank, through the valves, from the upper to the lower tank and out to the carburetor The principle used in creating the illusion of the rising or falling of liquid in a tank, or its flow through a pipe, is simple and can be applied in a number of ways In the case of a tank, a piece of transparent celluloid is cut that will fit in the tank drawing, and provision is made for moving it up and down while showing only that portion which should properly be shown in the tank; the exact method will depend upon the nature of the job. On the celluloid lines are drawn, much as in drawing the conventional water of the drawing-board When this is moved and photographed as described, the lines are "lost" on the screen and there is left the illusion of movement of a transparent body. By using celluloid the tank can still be seen through the liquid, making the illusion so much more complete Other equally simple tricks are employed to show the liquid falling in a broken stream and splashing foamily into the tank

Part of the animator's stock in trade consists of unlimited patience Such a picture as that of the vacuum fuel-feed will run about 400 feet With sixteen frames per foot, this means a total of 6,400 frames Some of these are run off rapidly under the camera, where there is no motion to be shown There remain, however, about 5,000 frames that must be exposed individually, each after a careful setting of a number of parts. Small wonder, then, that the making of a film that will show on the screen for three or four minutes may involve anywhere from two days to two weeks of work under the animating camera—to say nothing of the time required for the preparation of the mechanigraphs by the draughtsmen and artists

There are cases where it is necessary to show movement that cannot be simulated by the methods already referred to For instance, suppose it is desired to make a mechanigraph of a power driven tire pump, such as is used in automobiles In order to get the whole pump in section at the same time it is necessary to draw it in the plane of the crankshaft This gives an edgewise view of the gears and crank; yet their motion must be shown In the case of the gears the "three-position" trick, well known to animators, is used A drawing of the gear is made with the teeth carefully placed and spaced Then a second is made precisely similar, but showing the teeth advanced through a distance equal to one-fourth of a tooth and a space, and a third shows a similar advance over the second The first gear is laid in position and photographed—a single frame Then the second, and then the third Then the first is laid down again, and the second and third, and so on, for as many feet of film as may be necessary If the drawing has been properly done the projected picture will show perfect motion The person who is informed on the subject of motion pictures will recognize at once the connection between this procedure and the various illusions which are encountered in photographing the wheels of a moving vehicle

The crank has to be handled differently, for it changes its appearance as well as its apparent length with every move throughout its swing. A separate drawing is made for every position of the crank, and cut out. The cut-outs are laid down one at a time and photographed, the piston and connecting-rod positions being changed each time the crank is changed. When the connecting rod moves back—that is, away from the spectator—it naturally goes into the shadow of the cylinder and crankcase. So a separate piece, precisely like the connecting rod but darker, is laid on when the rod is in the shadow. This gives the impression that the rod swings back and forth, when in reality it simply moves straight up and down.

There are innumerable other tricks and devices that are called into play by the mechanical animator, and many pieces of special apparatus are devised to attain specific results. Many of these ideas are more or less jealously guarded as "trade secrets," but the truth is that once a picture is shown on the screen, a good animator can figure out pretty accurately how it was made, and can generally do the same thing himself. There are few set rules and processes in the type of mechanical animation described. Every job brings its own individual problems, and solving them involves ever new schemes and tricks—it is just one little invention after another. But this very fact makes the work more than fascinating in spite of its difficulties, and the greatest reward an animator can ask is a perfect picture on the screen This brings with it a thrill even beyond that of the author who sees his work in type for the first time.

Counting Electrons

(*Continued from page 465*)

tral, but has a positive charge of one or two or more electronic units, according as one or two or more electrons have been detached by the passage of the alpha rays through it. If then this atom is just underneath the drop of oil, it is thrown instantly by the electric field into the latter, and then if you are observing you see something interesting

Suppose you look through a telescope with a scale fixed in the eyepiece? The drop of oil shows up like a very minute star on a dark background. You wait a few seconds after turning the lever which exposes the gas to the alpha rays Bing! You have bagged an electron, or possibly two These are the positive electrons of the nucleus of the atom whose negative satellites were knocked off by the alpha ray. Instantly the atom, carrying now its extra positive electron or electrons, strikes the oil drop The drop begins to move up —very slowly and regularly, for the laws that govern falling bodies are suspended in the case of minute droplets in a gas, and the speed of the oil drop remains constant From the rapidity with which it moves you can see at once whether you have caught one or two electrons, for in the latter case the drop will move just twice as fast as in the former one

In his lecture on the structure of the atom Sir Oliver Lodge has stated that we may well fear future wars if the terrible secret of how to utilize the energy contained in the atom falls into the hands of an uncivilized power. Not only human life, but the whole planet, could be destroyed, he asserts Radium discharges alpha particles with sufficient force to carry them around the world in a fraction of a second—at a velocity that is really only a little bit slower than that of light This power is dormant in each atom; if we ever learn how to release and control it for our own purposes the fuel shortage will mean nothing at all in our lives, and the invention of ways for making synthetic gasoline out of water plus a mysterious green powder at a cost of a cent and a half a gallon will go wholly out of vogue, because such fuels will be ruinously expensive alongside the atomic source of energy.

A Steam Locomotive as a Punch-Press

(*Continued from page 467*)

drilling machine driven by compressed air, suspended from a jib and maintained at the right level by a counterweight. The cup cooling was so devised as not to water-harden the metal; it merely imparted to it sufficient resistance to prevent the punch from driving through the base of

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the cup While the cup was being made ready, the man in charge of the punching inserted the first die, duly greased, his assistant then placed the base of the cup in the die, the regulator valve was opened and the punch drove the cup through the die As soon as the forging had been driven through, the die, which in the process had been raised and placed exactly in the axis of the cylinder, fell back in its seating and constituted a stop which helped to strip the forging from the punch as the piston traveled backward The forging then fell on a gutter plate, whence it was removed and replaced on the punch when the piston was in the rear position

During the time occupied in this the man in charge of the punching operations replaced the first die by a smaller second one, when the drawing down continued in practically the same way, the second die acting also for stripping the forging from the punch. The third pass proceeded in a similar manner, but before this, the forging was slightly reheated During the drawing-down operations, the punch was cooled by water jets and the dies were freed of scale, cleaned, greased and placed in order for each successive operation

Besides the regulator valve handle, the engine driver had within easy reach an air-brake valve which was used to brake the driving wheels at the end of each revolution and to stop the crank on the rear dead center As soon as the forging had been driven through the die, and although the regulator valve was immediately closed the inertia of the driving wheels frequently resulted in two or three revolutions at comparatively high speed before the piston could be stopped at the back end of its travel This resulted in somewhat heavy jerks which shook the wheel scotches, it sufficed, however, to inspect the position of the scotches every morning and to strengthen them where this was found to be necessary

The installation ran successfully for about two years and produced several hundred thousands of 75 millimeter shells, pending the putting down of a more suitable hydraulic plant It enabled the works, from the very commencement of the war, to do away with the manufacture of shells by boring out of the solid, thus saving a large quantity of metal, and much time and making the machine tools which would thus have been utilized available for other pressing munitions work

An Alternative to Einstein

(*Continued from page 468*)

earth exactly, for that of Mars within 0 08 per cent Corresponding figures for Einstein as his theories are superposed upon ordinary astronomical practice are 0 2, 37 5 0 2 and 0 4 per cent In the cases of the inclinations of Mercury, Venus and Mars Dr Poor has discrepancies of 0 15, 1 8 and 5 3 per cent, while Einstein's discordances inherited from older theory are 5 3, 9 8 and 0 4 per cent In the matter of the nodes Dr Poor's debts to observation amount to 0 04, 0 08 and 0.15 per cent and Einstein's inherited difficulties come to 6 8, 0 6 and zero per cent We may remind the lay astronomer that the earth has no inclination and no nodes because it is always in its own orbit, whose plane measures these items in the other planets

Dr. Poor has the advantage in eight cases out of ten; if we try to weight his advantage by the usual method of least squares, he has the better of the argument on a basis of about 30 to 1 *Controversially* it might be maintained that he has given the Einstein theory a fair run, since the results attained by it and quoted in the above discussion are stated by its proponents as ground for accepting it As a matter of fact, however, Dr. Poor's own system is simply the Newtonian system, allowed the benefit of greater exactness than it has ever before enjoyed For a fair comparison, we must of course allow Einstein the same benefit If we go independently through the operation of determining the characteristics which the solar envelope would have to possess in order best to reconcile calculation under the Einstein law of gravitation with the observed facts, we arrive of course at a different distribution of the zodiacal material, but one equally in accord with physical possibilities, and if this distribution be realized, Einstein's discrepancies are greatly reduced, but are still greater than those of the Newtonian theory as reinforced by Dr Poor In place of a thirty to one comparison, there is now a preference of three or four to one in favor of Dr. Poor according to the least square verdict

For the benefit of the layman who does not realize as clearly as he might just what the scientist means by an assumption, it ought to be emphasized that Dr Poor does not present these calculations as proof or even as evidence that the material of the solar envelope is arranged thus and so He might with some show of provocation make this claim, in view of the fact that Einstein's hypotheses are often held by his followers to be proved by the verification of one or two of their consequences, but he carefully refrains from any such unjustifiable claims His whole purpose is merely to prove that Einstein's assumptions are not necessary to account for the behavior of the planets He proves *this by showing that it* instead of assuming the things that Einstein assumes, we assume something else the observed facts are accounted for as well as by Einstein's postulates, if not actually better *If* the zodiacal matter is arranged as Dr Poor suggests Einstein's theory is superfluous and in fact hardly tenable That is all Dr Poor has attempted to show, unless we make some reservation in connection with his efforts to point out that the arrangement which he discusses is entirely a possible one and in full accordance with what little we know of the distribution of the circumsolar matter

In the present state of knowledge, then we must say that the planetary motions do not furnish a definite test of the validity of Einstein's hypothesis or of Dr Poor's hypothesis It becomes a problem of observational astronomy to push investigation to the point where one or the other of them may be disproved Until then, the proponent of either system may say that it fills the bill with an accuracy that satisfies him that its assumptions appear to him to be reasonable, and that its subsidiary features are such as to make it appeal to him more strongly than the other—but he may go no further than this so far as the evidence of the planetary motions is concerned The writer believes that the subsidiary features of Einstein's theory weigh so heavily in its favor as to leave little choice, but that is only an opinion Such opinion, or even a universal consensus in the same direction, would not be competent to eliminate Dr Poor's suggestion which can be disqualified only by direct observational evidence disproving one of its assumptions or one of its consequences

New Sources of Pulp and Paper

(*Continued from page 469*)

the bamboo and other plants named

In reeds and grasses the cellulose membranes are less permeated with lignin and a smaller quantity of alkali is consequently required for their reduction to paper pulp than is the case with woods or plants of solider stems. In Germany, Czechoslovakia, and Roumania the stalk sheaths and leaves of Phragmites and Typha have been used for the preparation of cellulose with satisfactory results The root stock of Phragmites is made to yield alcohol before being pulped

The reeds used in this country for the manufacture of floor mats, etc, might prove a good source of paper pulp, and

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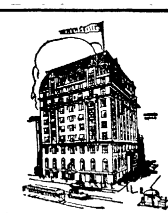

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the waste from mat factories might also be experimented with The dried plants are best adapted for use, since the green material contains coloring matter which makes bleaching difficult and expensive Before harvesting the plant it should be allowed to stand from the actual time of ripening until winter sets in This permits a more thorough drying and the mechanical action of air and cold favors the rupturing and weathering of all the cell constituents The stalk and sheaths of the plants are considered the most suitable materials for pulp on account of their higher yield of cellulose fibers, amounting to between 30 and 35 per cent

The cells of which the fibers of reeds and grasses are composed are short rather wide in proportion to their length and thin-walled While these characteristics render the fibers unsuitable for conversion into the finer grades of bond and writing papers, they facilitate and cheapen the production of the pulp for purposes for which it is suitable

It is not an idle dream to look forward to a time when pulp and paper manufacturers will have abandoned their present methods of obtaining cellulose fibers and treat paper pulp as a by-product of manufacture rather than a main product From the tree or plant a whole range of valuable organic derivatives might be first extracted leaving the cellulose, cell walls or skeleton of the plant to be utilized last of all It is the tendency of modern methods of manufacture to proceed in this way, but it must be confessed that it is a far glance into the future where the paper industry is concerned

As has been pointed out by Steinmetz, it is not so long since the coal tar produced in coke ovens was thrown away as a useless waste material In the manufacture of sulfite pulp the waste liquor of the cooking process is regarded similarly and the great bulk of it is washed into rivers and water courses to their pollution only a small quantity of the available material being utilized as roadbinders, or for cementing foundry cores, and still less as a source of alcohol after fermenting the sugars contained in it May it not be, that like the former waste product, coal tar, sulfite waste liquor may yet be made to yield many valuable organic chemical substances and evolve a new and profitable industry?

Sixty Tons Per Minute

(Continued from page 470)

trimmer device has maximum dimensions of 7½ by 9 5/6 feet It will go into pretty much any hatch larger than 8 feet 11 inches The trimmers are electrically operated They are a product of the designing ability serving the railroad

Some may think the throw of the trimmer very likely to break up the coal It should be remembered, however, that the most of the throwing is done in directions not greatly different from the horizontal In other words the coal may be thrown a fair distance horizontally, but drop only a short distance vertically It is the drop that is mostly responsible for breakage In fact, the operation of the trimmer is a good deal like that of a man throwing coal with a shovel Only, in this case, the shoveler is a giant of a fellow

The great pier is a notable affair of concrete and steel It is built low and by this style of construction avoids the excessive cost incident to the building of great tall steel structures like those at Hampton Roads On the other hand, there is perhaps a greater amount of power driven apparatus connected with the Baltimore pier The capacity is reckoned at 12,000,000 tons per annum—that is about half the tonnage transferred from rail to ship either at New York Harbor or at the harbor of Cardiff, Wales It is understood that, if this pier were now to be constructed, the cost would be double the $2,500,000 actually expended.

Valuable Binder Material from Waste

(Continued from page 471)

tons capacity each without incineration or objectionable odors or fumes Any tonnage of garbage can be handled according to this arrangement, and within a period of eight hours the entire volume of refuse can be disposed of without cooking This is a great improvement on the many methods of garbage disposal now in use

The incineration system of handling municipal wastes of this description always was very expensive and generally unsatisfactory The reduction method which features special treatment to obtain the oils and fertilizing materials contained in the garbage is also very costly and generally is maintained at a loss in cities which follow this plan The practice of feeding garbage to hogs is yet in an experimental stage and is not adapted for general practice due to the variation of local conditions in different cities These facts all combine to endorse the new *method of garbage disposal now opened* up Of course under actual operation, this method also may develop weak points but at present it looks like the prize method of the lot

Cardboard treated with this binder and then placed in boiling water for two hours has been used as a container for oil without any signs of leakage for over ten months Some of the coarser cotton clothes which have been treated with this adhesive have withstood the wear and tear of emery wheel tests under laboratory conditions which would mean rack and ruin to similar cotton clothes before being treated Cement sacks have been made and tested thoroughly which not only are water and moisture-proof, but which also are more durable than the bags of this kind now in use It costs only six to seven cents a hundred pounds to water proof ordinary paper with this substance Paper and fabrics treated with it not only resist water and acid penetration but also are proof against the entrance of oil or chemicals In one corner of the Mohler testing laboratory are three concrete tanks which were treated on the interior They have been filled with crude oil, kerosene and gasoline, respectively, for the last ten months and as yet there are no evidences that any of these materials have actually penetrated the cement walls

The Current Scientific American Monthly

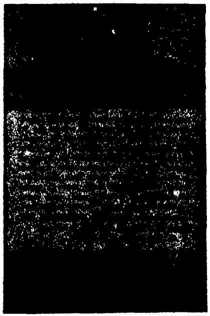
(Continued from page 473)

artificial pearls The "orient essence" used for coating glass beads was taken from certain fish caught in French and Russian waters When this supply was cut short by the war, American manufacturers besought the aid of the Bureau of Fisheries which discovered that the scales of the shad and the sea herring were capable of furnishing as choice an essence as those of imported fish, and now artificial pearls are being made from a product of American waters

"Warming Buildings with Refrigerating Plants is the title of an article by Robertson Mathews of Cornell University, in which he shows how our vast natural supply of low temperature may be utilized

In view of the coming attempt to scale the heights of Mt Everest, special interest is attached to the article on "Mountain Craft," which goes into considerable detail in explaining the regimen, walking manners and equipment for mountain climbing

In addition to the over score of articles and numerous notes, the June number contains the usual departments, giving the latest progress in science and various branches of technology.



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TESTING THE STRENGTH OF CONCRETE BY MEANS OF A SCALE AND A BUCKET OF SHOT.—[See page 486]

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June 18, 1921

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From a painting by Howitt showing one of the coal lines during the "shortage" when even limousines called daily for the allotted bushel. And yet the majority of people in the line were guilty of wasting tons of coal in the manner described.

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Showing how the felting of Asbesto-Sponge gives flexibility, so vital to long life.

Johns-Manville 85% Magnesia—the standard of the moulded class of insulations.

This type of material marks the success of an endeavor to increase the life of insulation which of course means greater economy to the user than the older molded types of material.

This material is most durable under the wear and tear of application and use. It is built up, in felted ply form and hence will not grind away under vibration, and more remarkable still—it shows the highest heat saving efficiency of all commercial materials.

Look about you for bare hot surfaces, whether pipes, flat surfaces or irregular ones, for whether they are in the home or factory you may be fairly certain that the heat they waste will soon pay for the cost of insulating them with any of these materials listed below which we will prescribe and apply for you.

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SEVENTY-SEVENTH YEAR

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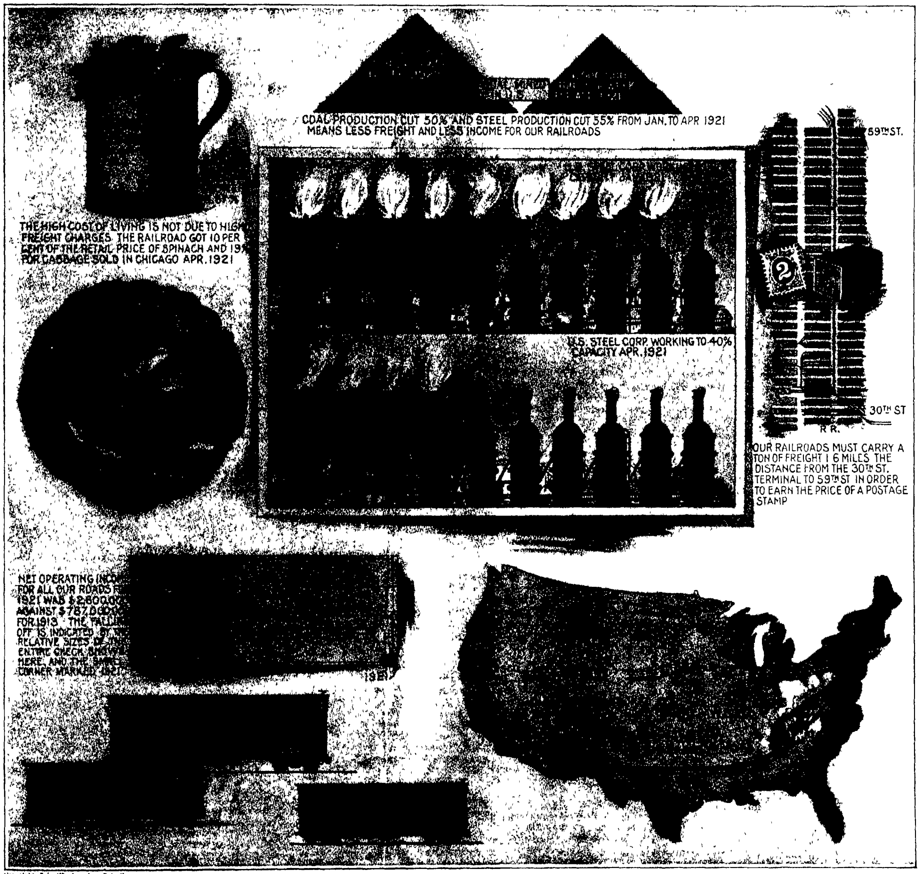
COAL PRODUCTION CUT 50% AND STEEL PRODUCTION CUT 55% FROM JAN. TO APR 1921 MEANS LESS FREIGHT AND LESS INCOME FOR OUR RAILROADS
THE HIGH COST OF LIVING IS NOT DUE TO HIGH FREIGHT CHARGES. THE RAILROAD GOT 10 PER CENT OF THE RETAIL PRICE OF SPINACH AND 19% FOR CABBAGE SOLD IN CHICAGO APR. 1921
U.S. STEEL CORP. WORKING TO 40% CAPACITY APR. 1921
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OUR RAILROADS MUST CARRY A TON OF FREIGHT 1.6 MILES THE DISTANCE FROM THE 30TH ST. TERMINAL TO 59TH ST. IN ORDER TO EARN THE PRICE OF A POSTAGE STAMP
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SOME FACTS AND FIGURES THAT DEMONSTRATE THE RELATIONSHIP BETWEEN OUR RAILROADS AND OUR INDUSTRIES TODAY AND IN THE RECENT PAST, AND THAT SERVE TO INDICATE THE PLIGHT OF OUR TRANSPORTATION SYSTEMS—(See page 484)

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The Peril of Floods

THE disastrous flood of the Arkansas River with its accompanying loss of life and property, particularly in the city of Pueblo, is one of those calamities of Nature's making, against which we can never hope completely to safeguard ourselves, except at enormous inconvenience and expense. There is no mystery about the causes of such floods. They are to be found in the configuration of the terrain coupled with a heavy rainfall, of unprecedented duration and wide area, falling upon thoroughly dried-out ground. In the Arkansas flood, before any considerable absorption of the rain could take place, it had swept, practically undiminished in volume, into the Arkansas River, which no longer confined to its banks, poured in a valley wide torrent through the devastated area.

The Arkansas is a river which is contained between high banks throughout the greater part of its route and when the mass of water, flowing off with great rapidity from the mountains and upper regions of its watershed, reached the open valley in which Pueblo stands it encountered the backwaters from a flood of the Fountain, a tributary river, which unites with the Arkansas at Pueblo and was itself heavily flooded.

To the meteorologist and the engineer, there is nothing mysterious about such a flood as this. It is well understood that an enormously heavy precipitation covering a wide area of a watershed, particularly where the topographical features are similar to those in the Arkansas watershed, will inevitably produce a flood of great magnitude. Fortunately, the records show that while any such river is liable to regularly-recurring floods which are not dangerous to life and property, floods of greater volume and accompanied with some destruction occur only at intervals of ten to twenty or thirty years, while such an overwhelming flood as this, according to one of our leading hydraulic engineers, is not likely to occur more than once in a thousand years.

It is possible absolutely to prevent disasters from a flood of this magnitude only by ceasing to build towns, villages and farmhouses in the bottom lands or upon the banks of such a river as the Arkansas. This, however, would involve the abandonment of the most fertile lands of the valley which, because of their alluvial deposit, are richer in the bottoms than on the foothills. But this, in the case of many valleys of the West, would mean the abandonment of these districts altogether. Cities, again, have ever been built upon the rivers, and the farmer has ever chosen his farm from the rich soils of the bottom land, and this selection will continue to be made. Not even the eruptions of Vesuvius suffice to drive the thrifty husbandman from the lower slopes of that mountain. Human nature is easily forgetful of calamities, and is always ready to purchase a present gain at the risk of future penalty. Nor is devastation such as that in the Arkansas Valley a sufficient reason for abandonment. First for the reason, as given above, that the possibilities of a repetition of a flood of this magnitude are extremely remote, and secondly because it is possible, by the erection of dams in the upper watershed, to provide storage basins of sufficient magnitude to hold back the flood waters and prevent their pouring in one great devastating rush through the valley below. The provision of such regulating works, coupled with a proper reinforcing of the banks of the river at certain strategical points, would render impossible a repetition of the Pueblo disaster. The great flood in Ohio several years ago was broadly similar in its causes and effects, and the regulating works which have been subsequently built have relieved the residents of Dayton, Ohio, from fear of any repetition of the disaster of 1913.

Great as is the Pueblo disaster, with its many dead and a property loss of fifteen to twenty million dollars, previous floods have greatly exceeded these totals in the total damage done. Thus the Dayton flood cost six hundred lives and three hundred million dollars in the state of Ohio alone, and the Mississippi flood of the year before produced a property loss of between eighty and eighty-five millions. Every state in which floods of great magnitude are liable to occur should follow the plans laid down by the Pittsburgh Flood Commission, a highly technical body, which called for the construction of storage reservoirs, the improvement of river channels, and the protection of banks by well-known and proved methods.

Enormous Waste In Industries

THE committee which was appointed by Herbert Hoover, now Secretary of Commerce, when he was chairman of the American Engineering Council's Committee on Elimination of Waste in Industry, has made public a report which, because of its valuable and highly authentic information, should be read and studied by capital and labor alike. The startling and almost sensational facts and figures of the report must not be allowed to throw any doubt upon its truth. The habits of careful and exact thought which characterize an engineering body of this quality preclude any suspicion. This inquiry into industrial wastes is the first definite step of the organized engineers of the United States, some 200,000 in number, to secure better industrial conditions and promote harmonious relations between capital and labor.

A summary of the report shows that the margin of unemployment is more than a million men, that billions of dollars are tied up in idle equipment, that the most frequent cause of waste is high labor turnover, and that millions are annually wasted in loss of time and capital through duplications, estimates and bids in the building trades. The charge is made that the employer as well as the employee restricts output, but although both capital and labor are guilty in this respect, it will come as a surprise to the public to learn that the waste by conflicts between capital and labor is much less than is popularly supposed.

As to unemployment, we are told that from four to five million workers were idle during January and February of this year, and that in 1921, 500 million dollars will be lost in wages in the building trades alone.

On the question of preventable disasters and death, the committee states that the annual economic loss to the country from this cause amounts to three billion dollars. It asserts that 75 per cent of the deaths and serious accidents in industry could be prevented by a more general use of safety methods which have been perfected and proved. We are told that in 1919, there were three million industrial accidents which resulted in an economic loss to the country of about 850 million dollars.

The printing industry should take note of the fact, according to this report, that an investment of more than 100 million dollars in stocks of paper carried to meet trade requirements could be cut in half through standardization in the brands of paper. As to efficiency, we are told that the building industry is about 60 per cent efficient; that the waste in the shoe industry is about 35 per cent, and that in the ready-made clothing industry it should be relatively easy to save $375,000 every day of the year, which would mean an increase of 40 per cent in effectiveness.

So much for the disease. As to the remedy, the committee lays down the following proposed program by which the Government may assist in the elimination of waste. A national industrial information service to furnish information covering current production and consumption and stocks of commodities should be established, a statistical service covering employment requirements should be set up, the Government should encourage and foster a national policy regarding public health, those who have physical defects and have suffered industrial accidents should be assisted by a national program for industrial rehabilitation; a nationwide program of industrial standardization should be encouraged, the Government should revise such Federal laws as interfere with the stabilization of industry; and, finally, a body of principles should be accepted which could be developed for the adjustment and settlement of labor disputes. All of these are excellent recommendations which should commend themselves to the thoughtful consideration both of Congress and of the people.

Rolling Reduces Speed at Sea

TO most of us mortals the thought of a ship rolling heavily in a seaway serves to bring a twinge of unpleasant memories or a shudder of dire foreboding—just that, and nothing more. But at the last meeting of the Society of Naval Architects and Marine Engineers in this city the question of the rolling of ships was viewed from the very practical angle of the serious retarding effect which rolling has upon a ship, and the great increase in power which is necessary if the speed is to be maintained. The discussion was based upon a paper by Commander William McEntee, of the Construction Corps of the Navy, in which he gave the results of comparative tests of bilge keels and a gyro-stabilizer, made in the Navy tank on a model of the United States aircraft carrier, "Langley." The "Langley," a 520-foot ship of 11,000 tons' displacement, has been reconstructed as an airplane carrier, and since airplanes are intended to take flight from her deck and land thereon after a flight, it is, of course, highly desirable that her deck, considered as a platform, should be rendered as stable as possible.

There are two ways of preventing the rolling of ships—namely, bilge keels and the gyro-stabilizer. In these experiments, artificial waves were produced, while a model of the "Langley," 23 feet long and capable of supporting a dozen people, was towed down the tank, while rolling was produced by setting up wave action in the tank. The model was tried first in still water, with bilge keels, and then with the bilge keels removed and the stabilizing gyro in place. We are told by Commander McEntee that without bilge keels, in still water, the model after being keeled over, required 54 swings to reduce the angle of heel from 11 degrees to 3 degrees. When the bilge keels were in place, only eight swings were necessary.

The model was next rolled with and without bilge keels, and then with the gyro-stabilizer, all three tests being made amid artificial waves. For this purpose it was held broadside to the waves by single head and stern lines, made fast to the model at the waterline close to the longitudinal rolling axis. The bilge keel reduced the arc of the roll from 26.4 degrees to 9.6 degrees, whereas the gyro-stabilizer reduced it very quickly from 34 degrees to 3 degrees. The results of several other tests were given in the paper, and they all demonstrated the, we had almost said, uncanny, way in which the gyro-stabilizer damps out the rolling of a vessel.

Another important point brought out in the paper was the increase of towing resistance of the model if it were rolled while it was being towed in smooth water. It was found that at a speed of 15 knots, the effective horsepower of the "Langley" would be increased from 3,000 to 3,300 when the ship is rolling through an arc of 25 degrees, and to 3,600 when she is rolling through an arc of 45 degrees, which corresponds to an increase in effective horsepower of 10 per cent and 20 per cent, respectively.

We confess to no little surprise at these figures, but, coming from such a source, they are incontestable. Furthermore, Commander McEntee points out that this does not include the loss of power due to decrease in propeller efficiency for a twin-screw ship, when, in rolling, the propellers alternately approach the surface if they do not actually come out of the water. There must also be yet another loss, due to the yawing of the ship and the resulting resistance as the rudder is put over from side to side to correct this. Yawing could not occur in the model, since the tow lines were sufficiently taut to keep the model on a true course.

Just how great the loss through free use of the helm may be was dwelt upon by Mr. Elmer A. Sperry in the subsequent discussion of the paper. He calculated that there is about 17 pounds per square foot retardation with the helm only three degrees over. Presumably, his figures are for the "Langley," but for what speed he did not state. Everybody will agree with him, however, that when a ship is rolling heavily, the busiest man of all is the helmsman.

Electricity

A Daily Market Report prepared by the U. S. Bureau of Markets is being sent out by radio from the laboratory of the Bureau of Standards at 5 P. M. each day except on Sundays and holidays. This report, known as the Daily Radio Marketgram, is about 500 words long.

Welding with Two Arcs in Series.—In a recent issue of *L'Electricien* there is outlined a scheme by means of which it is feasible to connect two welding places in series, both being fed from one direct-current generator. Two contactor relays and two substitute resistances are necessary to permit the two welders to operate independently of each other. In case one of the arcs goes out the relays cut into the circuit the substitute resistance, which is short-circuited when both arcs are in operation.

Radio in Indo-China.—It has been decided to utilize radio telegraphy as a means of communication between Saigon and Hanoi. The submarine cable which connects Cochin-China and Tonkin is subject to frequent breakage, the cost of repairing which entails greater expense than the credits allowed, and for lack of credits it has been impossible to repair a breakage which occurred in October, 1919. However, in order to assure continuity, permanence, and the regular service of telegraphic communications, the Governor General of Indo-China considers the employment of the coast cable as still necessary, and he proposes to assure all the expenditures entailed for the latter out of the budget of the colony.

Improvement in Cavite Radio Station.—Recent improvements in the naval radio telegraph station at Cavite now enable the transmission of radio messages from the Philippines to San Francisco without relay. A large increase in electrical power and the construction of telegraph lines between Cavite and Los Banos are responsible for this direct Pacific radio service covering some 7,000 miles. Formerly dispatches from the islands to points in the United States were copied at Honolulu and relayed to the mainland. This meant unnecessary delay in transmission. The improvements will treble the capacity of the Naval radio service to and from the Philippines. The Naval radio station at Cavite and Los Banos are handling a daily total of approximately 12,000 words.

The Shanghai Radio Station.—Under an agreement with the Government of China, the Federal Telegraph Company, an American concern, will very shortly commence the erection of a radio telegraph station at Shanghai larger, it is said, than any now in existence. While the kilowatt capacity of the station is the same as that at Bordeaux, France, this new station will have six masts, each a thousand feet high, whereas those at Bordeaux are only 826 feet in height. The station is to be completed within 18 months and will have sufficient capacity to transmit and receive messages across the Pacific without the necessity of relay. The company will also erect other stations at Peking, Harbin, and Canton, which, together with the Shanghai station, will give China unexcelled wireless facilities.

Electrification of Jamaica Railroads.—At the request of the Jamaica Imperial Association, the Jamaica Government two years ago voted £1,000 for investigations of the possibility of electrification of the Government Railway. This forms the only means of transportation across the island, either for passengers or for freight, except by truck and wagon on the public roads. One branch runs from Kingston in a roundabout way to Port Antonio on the northeast, a distance of 75 miles. A second branch runs from Kingston to Montego Bay, on the northwestern corner of the island, a distance of 112 miles, while a third short branch completes the total mileage of 197 miles. Since this railroad is entirely dependent upon imported coal, which is very expensive here, the authorities have desired to make use of the water power on the island.

How Glasgow Saves Current.—Folks who believe hustle and bustle in everyday life is a characteristic confined strictly to the Western Hemisphere would do well to visit Glasgow, according to an engineer writing in *Electrical Review*. "In all the time I was in the busy Scotch metropolis," states this engineer, "I never saw a streetcar stop at any but few stipulated stations. At all other places the motorman merely reduces the speed of his vehicle when he is hailed by a prospective fare and the latter makes his ascent to the platform on the fly. Men and women, young and old, have become so used to mounting the cars while they are in movement that the latter seem to be in a state of perpetual motion at all times." Obviously, such a practice saves considerable current in the course of a year, which may have appealed to the Scotch thrift.

Science

The "Roar" of an Ostrich.—A lecturer at the London "Zoo" said that very few people knew that an ostrich roared. The roars of an ostrich and a lion were so alike that Dr. Livingstone could never distinguish the difference, save by the fact that the bird roared by day and the lion by night.

Darwin's Son to Visit Us.—After the experiences of Dr. Einstein and Madame Curie, Major Leonard Darwin, fourth son of Charles Darwin, who is to visit us this summer should come incognito or he will be killed by kindness and the reporters. Mr. Darwin is an eminent scientist, his specialties being geography and eugenics.

Palestine Chariots.—Dr. Clarence S. Fisher, curator of the Babylonian section of the University of Pennsylvania Museum, will undertake what he described as one of the most important excavations ever made in the Holy Land and the first since the beginning of the World War. He expects to find among other things some of the iron chariots mentioned in the Bible which prevented the children of Israel from capturing Bethshan, near which city some of the greatest battles of early history were fought.

X-Ray Dangers Beyond the Laboratory.—A paper presented to the Paris Academy of Sciences recently maintained that X-rays are not only capable of injuring those actually working with them, but also of penetrating the walls and ceilings of buildings and becoming a source of danger to neighbors. The writer presenting the report, who is a doctor, advised covering the walls with lead in order to protect those who, in spite of themselves, are daily exposed to this real danger.

The John Fritz Medal to be Taken to England.—The engineers of America will send a deputation to England to carry and witness the award of the John Fritz medal to Sir Robert Hadfield at the meeting of the British Institute of Civil Engineers on June 29th. The deputation to England will consist of a representative of each of the four Founder Societies represented on the John Fritz Medal Board of Award. The medal was awarded to Sir Robert this year because of his invention of manganese steel.

Lightning Zones.—The timeworn theory that "lightning never strikes twice in the same place" has been modified by forest experts of the United States Department of Agriculture to this extent. Lightning very often strikes in nearly the same places. It has its zones, in other words, where its appearance may usually be counted on with each electrical storm. With the accumulation of data on causes and locations of fires in the national forest, these lightning zones could be mapped out and protective measures introduced—such as fire lines, regulated grazing and cleaning out of dead trees—which would more or less automatically control lightning fires at the start, the foresters believe.

Elephants Raid a Railway Station.—We are used to stories of how an elephant occasionally upsets a circus but it is rare we hear of an orgy of destruction like that which occurred in the Malay Peninsula. A herd of wild elephants attacked a railway station, pulling down the station master's kitchen and bathroom. They did the same to the clerk's quarters and then tackled the station while the office force looked on from trees. One elephant took off an automatic weighing machine as a souvenir of the raid, but finding it heavy, threw it down on the track. One of the elephants trumpeted the recall and they all went back into the jungle except one who fell in a well and had to be cut out by human aid, but was not detained. By the time help arrived after a general telegraphic alarm the huge beasts had entirely disappeared.

Human "Trimmings."—A curious case in the courts in New York was recently withdrawn before trial. A doctor used part of the patient's "left over" or anatomical debris to graft on another patient. The counsel for the New York State Medical Society said that although the question whether the detritus after an operation was the property of a patient and whether he could get damages because some of it had been used remained undetermined. He thought that analogous decisions would indicate that any individual might have the right to direct the disposition of any part of his body and that because abandonment was one method of disposition of property recognized by law, it would appear that unless some disposition actually was directed, the patient might be said to have legally abandoned parts necessarily or incidentally removed during an operation. Hence, he believed in the absence of a definite disposition that no damages could be got because such parts were used in an operation on another patient.

Industrial Efficiency

Chinese Flour.—At a time when there are so many appeals for funds with which to purchase flour for shipment to the Chinese famine victims, it is rather unbelievable that in normal times China produces sufficient flour for export purposes. Yet in 1920 almost 6,000,000 barrels of Chinese flour were shipped to Europe. New mills are contemplated in the wheat-growing sections.

Oil and New Railroads.—Until it has been shown conclusively that oil does exist in paying quantities nearer to present transportation lines, railway transportation to the Fort Norman oil district will not be provided, according to D. C. Coleman, vice-president in charge of western lines of the Canadian Pacific Railway. Mr. Coleman states that geologists have declared that there is no reason why oil cannot be found in paying quantities in other regions of Alberta, and that this has been borne out by the fact that oil has been discovered recently near the Montana boundary.

From Pimento Oil to Vanillin.—The Department of Agriculture in Jamaica, after months of experiments, claims that an important trade secret has been solved. During 1920 a small beginning was made by the Department in the production of pimento oil in the hope of extracting vanillin. The first output of pimento oil was sold in England to manufacturers of vanillin at 10s per pound. Experiments have since resulted in the conversion of pimento oil made at the Government Laboratory into vanillin, but the researches have not as yet been completed for the present yield is only 50 per cent of what should be produced. It is confidently expected that this difficulty will be overcome.

Australian Artificial Veneers.—A recent Australian invention of an artificial composition similar to veneer should be of interest to manufacturers in proximity to large supplies of waste material of vegetable origin, such as sawdust. As patent applications are pending in Australia and other countries the inventor is at present reticent in furnishing details other than that the substance is worked up entirely from waste fibrous products and other vegetable matter and that sawdust can be utilized in considerable quantities in the manufacture of the cheaper grades of the composition. The substance can be used for a variety of purposes, such as chair backs and seats, furniture generally, veneers, and wall and other paneling, and can be produced to represent excellent marble effects. It is capable of being bent freely for a variety of commercial purposes, worked with tools sawn, bored, sandpapered, and so on, and will take nails with ease.

Work for British Unemployed.—The British Ministry of Labor states that there are now 17,000 men at work on the new arterial roads, in addition, at least an equal number over and above those ordinarily employed on such work have found employment on the program of road maintenance and repair work. Work has been accelerated on the layouts and sewers of housing schemes to employ an extra 4,000 men. The Office of Works has put in hand decorating and repair work in Government departments with a view to absorbing painters and similar work people unemployed to the number of 2,600. The short time system which has been introduced into establishments under the control of the Admiralty and the War Office has resulted in the employment of 8,059 men. Further, alternative work in various Government industrial establishments has been provided for 7,994 men. Grants have been authorized in the case of some 110 local authorities for the purpose of commencing approved works of public utility, and it is expected that the schemes sanctioned will give employment to 19,955 men.

New German Metallurgic Processes.—The attention of metallurgists is being attracted to a process recently invented in Germany which, it is declared, furnishes a simple, rapid, and effective method of separating alloys into their metal components and extracting metals from mineral ores. This process is said to present many advantages over the hitherto employed method of melting alloys and separating the metal components. According to this process the metals treated with the catalytic agents go into solution in a very short time, the treatment of big blocks of metal being effected in less than 30 minutes. Out of the solution thus obtained the various metals are dissected by the employment of simple methods of chemical reaction, which permit the retaining of the metals one by one. The product first obtained is in the form of a muddy sediment which, after being dried, yields a metal powder ready to be used or melted in crucibles, or to be treated by electrolytic process. Metals and concentrated ores can be treated in the same general way, although they require one or two more operations than pure metal alloys.

What Is the Trouble with the Railroads?

An Analysis of the Business Done by Our Transportation Systems, and the Rates They Are Charging for It

By Charles Frederick Carter

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Idle equipment at the New York Central yards near Kramer, N. Y. Because of the high cost of each of the locomotives and box cars, this represents a lot of invested capital that is earning no return

IN attempting to diagnose the lamentable state of the railroads so many ailments are apparent that the investigation must end in bewilderment and dismay unless it be confined within narrow limits. Avoiding controversial subjects, which include the graver aspects of the case, it seems obvious *that the trouble* with the railroads is deflation.

We may speak of deflation in surgical vernacular so far as it has affected the railroads. "The operation was a brilliant success but the patient died."

In order to understand how thoroughly traffic has been deflated it is necessary to review briefly recent performances of the railroads. In 1918 when the railroads were under Government management the freight movement for the year was 437,000,000,000 net ton miles, the greatest in history up to that time. The average load per car, 29.2 tons, was the highest ever achieved; the average train load, 681 tons, was also the largest up to that time. A new high record for cars loaded, 991,980 for the last week of September, was also established. Altogether the performance was wonderful. Comparing 1918 with previous history, the record of 1918 seemed a vindication of the views of those who advocate Government ownership.

However, events soon proved that even under Government operation railroads cannot haul freight that does not exist. Cars loaded in the first week of March 1919, while the roads were still operated by the Government, totaled 675,704, a decrease of 316,704 or 32 per cent from the peak in 1918. Net ton miles for the year 1919 aggregated 393,684,000,000, a decrease of 43,316,000,000 ton miles. The average load per car decreased to 28 *tons, a marked slump in efficiency.*

In March, 1920, the railroads were restored to their owners, under proper safeguards to prevent them from getting rich too quickly but still with many misgivings. Thus the owners had control of their properties for only three quarters of the year and that fraction included the outlaw switchmen's strike in the spring which seriously interfered with traffic. Yet, thus handicapped, the owners set a new high record for volume of traffic handled in 1920 with an aggregate of 445,975,000,000 ton miles, an increase of 8,975,000,000 ton miles above the previous high mark. The greatest freight movement in history was August, 1920, when the movement amounted to 42,056,000,000 ton miles, earnings on which were $555,000,000. The greatest number of cars ever loaded in a single week was 1,010,961 in the week ending October 18.

New records in efficiency in many ways were also established. The average load per car was 29.4 tons, the highest yet achieved. The *average train load* was 728 tons, or an increase of 10 tons above the highest average previously attained. If 1918 was a triumph for Government operation, 1920 was at least an equally convincing argument for the superiority of private operation.

Unfortunately for all of us the wonderful achievements of last fall were not to be continued. The decrease in the volume of traffic since October has been the greatest known. It has surpassed that following the panic of 1907 as well as that following the end of the war in 1918. Freight revenues dropped 33 per cent from October, 1920, to January, 1921, and declined still further to 36 per cent in February. Car loadings for the week ending February 21 showed a decrease of no less than 45 per cent as compared with the high record for the week ending October 18. For the first quarter of 1921 cars loaded decreased 1,616,013 as compared with the corresponding period of 1920, according to the weekly statement issued by the car service division of the American Railway Association. The number of cars idle during the week ending April 15, 499,479 was the largest ever recorded. Under such circumstances it is small wonder that the railroads should have found it necessary to drop 300,000 men from the pay roll.

If it is true that misery loves company it should be a great comfort to know that the woeful plight of the railroads is not peculiar to the United States. No less than 54 per cent of Canada's 40,000 miles of railroad failed to earn operating expenses in 1920, but 9 per cent did earn operating expenses and also the interest on some major securities, but nothing at all for dividends. Altogether the Canadian railroads, of which 52 per cent are owned and operated by the Government, have amassed a deficit of $140,000,000, equivalent to $17.50 per capita. That rate applied to the population of the United States would give us a deficit of $1,837,000,000 instead of only $1,200,000,000, which is the present estimated cost of our little experiment in Government operation. Operating expenses for the Canadian Government roads range from $1.00 to $4.10 for each dollar of revenues, so that these roads are costing the taxpayers of the Dominion $200,000 a day.

South Africa is in the same boat with Canada and ourselves. The annual report of the general manager of the South African Railways and Harbors for the year ending March 21, 1920, shows that the 9,541 miles of Government railways earned a deficit for the year of $2,721,318.

Even Japan, supposed to be a model of Oriental efficiency, was obliged to admit an increase of expenses amounting to $29,776,332 in earning an increase in gross revenues of $29,921,043 in 1919, the last year for which statistics are available. Without continuing comparisons further it may be conceded that the disastrous after effects of the World War are felt by railroads everywhere; and that the plight of American roads is by no means peculiar.

No profound research is required to find a reason for the abysmal depression in traffic. The railroads are not hauling freight because there isn't much freight to haul. Of the small remainder of traffic some of the transcontinental portion goes by water, including the Panama Canal, which was built and is maintained by the taxpayers and so is not charged with interest, depreciation nor any of the embarrassing items from which the railroad accountant cannot escape. Of the short-haul traffic an appreciable quantity goes in motor trucks over highways also built and maintained by the taxpayers instead of at the expense of those who profit by the use of the trucks. No matter under what euphemism the fact may be disguised the canal and the highways traffic is subsidized. Without attempting to consider the merits or demerits of subsidies in any form and certainly without pretending to argue against the utilization of whatever facilities for the movement of traffic may be available, present purposes will be served by calling attention to this factor, which, though a minor one, is still of sufficient importance to affect adversely the diminishing returns of the railroads.

Of course the major factor is the very great depression in all lines of activity. Since the steel industry is generally regarded as the most reliable barometer of business conditions the fact may be noted that for the month ending May 7 the United States Steel Corporation operated at a rate slightly under 40 per cent of capacity, which was a decline from 90 per cent of capacity in January. The rate of production of pig iron for the same period was a trifle more than 30 per cent of capacity. Independent operators were averaging 80 per cent of capacity. Although freight rates *are relatively low on steel and iron products they form* an important bulk of railroad traffic. The heavy decline in steel production, therefore, is of significance to the railroads.

Coal and coke also pay low rates but bulk large in freight traffic. Here the depression is even more marked than in steel and iron. The United States Geological Survey reports that production of coal has steadily declined from a maximum of 12,800,000 tons weekly in December to 6,000,000 tons April 1, the lowest, with the exception of the strike of 1919, since 1914. Indeed, considering the growth of the country, the decrease in production is even more acute than in 1914. It is necessary to go back to the panic year of 1893 to find a parallel. Transportation capacity which could add 6,000,000 tons weekly to current coal production, is lying idle while an army of men is unemployed or, at best, is working but a few hours a week. Domestic consumption and export requirements combined for the first quarter of 1921 were 20 per cent less than for the corresponding quarter of 1920.

Yet another important item of freight traffic is made up of building materials and equipment. The more optimistic of builders had hoped for 85 per cent of a normal year; but even this modest anticipation seems destined not to be realized. Export trade, too, has shrunk materially.

Having established as a reason why the railroads are not moving a large

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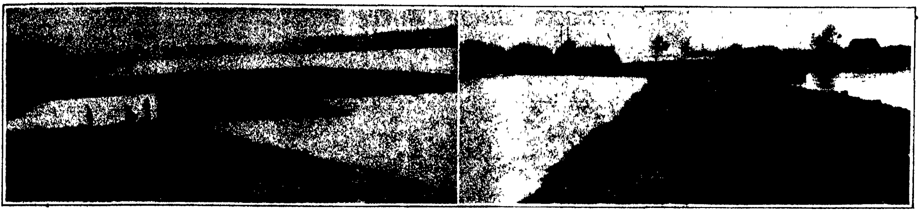
DIAGNOSES and prescriptions offered in the case of our railroads are as numerous as the diagnosticians and prescribers. The only difficulty is that no two of the self-appointed authorities seem to agree in their conclusions; and when doctors disagree we all know what is supposed to happen to the patient. Before giving up our transportation system to complete chaos, however, it seems that it might be worth while to make an effort to find out, without prejudice or prejudgment, what is really the matter with the railroads. We believe Mr. Carter is about as well qualified to speak on this subject as anybody. When he tells us that the roads are losing money because they are not doing enough business to make a profit at current rates and current rates of expense, he tells us what most of us know. But he makes it clearer, we believe, than it has yet been made—that the trouble is not with the rates—that these are entirely reasonable and proper. Indeed, this aspect of the question is so much his central theme that his contribution might well be entitled "What Is Not the Matter with the Railroads." We believe that Mr. Carter's article and the graphic comparisons of our title page based on it will give our readers some new ideas on the railroad problem.—THE EDITOR.



Left. Five miles of willow revetment like that here shown extends along the New Orleans water front. The picture shows the mat, which is made 100 feet wide by 150 long
Right: The cribwork, filled with sandbags, that closed the crevasse at Buras

Some of the works by which the Mississippi is placed under effective control at and near New Orleans

The Storm King Road

By J. F. Springer

As one sails north on the Hudson River, setting out from New York, he will at first have on his left the noted Palisades. But after a time, there will be mountain-like hills on the left and similar ones on the right. When he has got to a point just a little north of West Point, he will come to a remarkable mountain-hill on his left. The profile will rise like the brow of some enormous skull and then bend more decidedly away from the river. The steepness of the slopes at the lower levels and quite a way up will perhaps astonish him, so nearly vertical are they. This skull-like dome is the redoubtable Storm King, the most notable pile of rocks along the Hudson. Just across the river, on the east bank, is Breakneck Mountain, also a bold affair and not wrongly named

Round Storm King a state highway is under construction. This road swings round the gigantic knob in a splendid curve, rising to the north. Automobilists and others will get wonderful views from it, whether they look up the Hudson or down The gorge or valley in which the historic stream lies widens northward of Storm King and Breakneck It is as if, late in geologic times, the great ice sheet forcing its way south had been halted by these great masses of rock and had barely succeeded in forcing a narrow passage between them—the future passage of the Hudson River

The location is, besides, one of engineering interest. For here is the exact place where the great inverted siphon of the Catskill Aqueduct makes the crossing beneath the river At the foot of Storm King and close to the river, a shaft goes down to meet the aqueduct tunnel at a considerable distance below the surface The shaft then becomes the aqueduct tube and continues on down to a level that is perhaps 1,100 feet below the surface of the river. The crossing is then made at substantially one level The conduit then rises to a point at or near the surface at the foot of Breakneck and passes off as a tunnel toward New York City The crossing is thus of the form of a U with a squared bottom. The hydraulic gradient of the aqueduct is, at the region of the crossing, about 400 feet above the river's surface; so that the bursting pressures inside the aqueduct at the lower level of the crossing is, neglecting friction, etc., something like 650 pounds per square inch. The road round Storm King will afford opportunities to view from one spot both sides of the river at the siphon crossing. The observer will not see much on either side to call attention to the aqueduct, but, if he has the foregoing in mind, he can hardly help being interested in the broad fact that the arms of the U terminate in Storm King and Breakneck Mountain.

Storm King rises to a height of some 1,400 feet above the river Just south of it is a similar mountain-hill, Crow's Nest Mountain. There is a big notch extending back from the Hudson and lying between the two on the side next the stream. But this notch does not sever the one from the other Naturally, the road follows the flank of Crow's Nest and then the south flank of Storm King It rounds the steep face of the great pile and then goes on its way to Cornwall From West Point to Cornwall will, by the new road, be a distance of 4 miles. Those who follow it will save a detour amounting to three times the length It is impossible as yet to determine the cost The estimated cost, based upon plans and specifications and the expected quantities of excavation, is $717,583. But so many variations from the expected have taken place and so many minor changes seem advisable that the total cost may run up to a sum between $800,000 and $900,000 A big part of the expenditures will go for a 2,000-foot section on the front of Storm King On January 1, 1920, about 40 per cent of the total work of the road had been completed Some of the more difficult parts of the job were pretty well along In the near future it will be quite possible to motor from West Point to Cornwall by the new route and enjoy the magnificent views and note difficulties of construction that have been overcome Despite the winding in and out along the flanks of the two big masses of rock, it has been found possible to construct the road entirely in the open. There are no tunnels Nor are there any bridges There are open cuts and fills and ordinary construction There are plenty of sharp turns and some fair grades But 90 feet is the minimum radius of curvature and 7 per cent the maximum slope The narrowest subgrade in cuts is 24 feet wide and on the tops of embankments 26 feet. As a matter of construction economy, it was sought so to locate the road as to get just enough material from the excavations to fill in the embankments But this ideal has not been altogether realized Naturally, the fills over-balancing the cuts, this excess material has to be brought from its sources to the points of use The hauls necessary run up to 1,200 feet

The original plans have been viewed as subject to

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Controlling the Lower Mississippi

By Rozel Gotthold

CREST stages in the Mississippi and Atchafalaya flood occurred in 1920 during the latter part of the month of April The river gage at Natchez, Miss., stood at about 51 feet, at Baton Rouge, La., it marked about 39; and at New Orleans, 19.6 The highest flood stages ever recorded by the United States Weather Bureau occurred at Natchez when the river stood at 53.6 in February, 1916, at Baton Rouge when it recorded 43.8 in May, 1912, and at New Orleans when it was 22, at the same time Two crevasses occurred during April, 1920 neither bringing much damage because of the instant cooperation of the Federal engineers, the Louisiana State Board of Engineers and the members of the Levee Districts in the little towns themselves The first was at Buras, La., which is 75 miles below New Orleans, and a short distance above the United States Reservation at Ft Jackson The levee caved in on a farm there during the night of April 16-17 The next morning, which was Sunday, the inhabitants of this town filled 3,000 sandbags, ready for the State Board and Government Engineers, who arrived to plan the closing of the break Next came barges from New Orleans, loaded with lumber and thousands of sacks for filling A break of 450 feet was closed within a week It was filled with cribwork of the lumber into which sandbags were piled, the cribwork being sealed 4 feet each way The material was taken from place to place along the levee by mule-drawn flat cars, the tracks for which were laid in small sections along the levee as the work progressed

Buras is in the midst of a rich rice and truck-growing section It has also large orange groves and extensive oyster beds Everything would have been ruined had not the break been closed with dispatch Especially would the flow of fresh water to the Gulf have completely ruined the valuable oyster beds The cause of the crevasse was attributed, in the report of the Louisiana State Board of Engineers, not to high water, nor to the levee, which was protected from wave-wash by a wooden revetment in good shape, but to "subaqueous cause over which there was no control"

A levee is a simple piece of construction A typical one looks like nothing but a mudbank, yet it may hold within itself the very life and soul of great cities Upon the levee at New Orleans, for example, commerce

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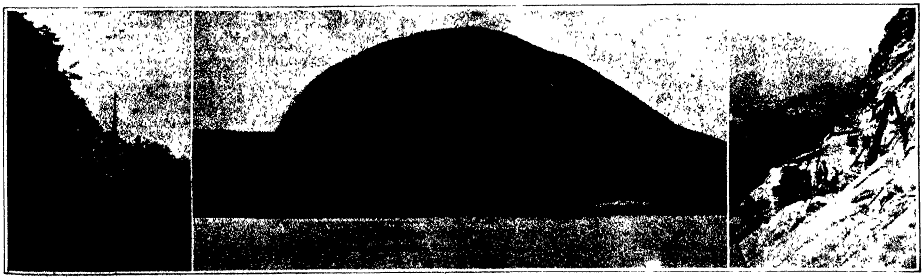

Two aspects of the construction of a road around Storm King, and a general view of the mountain from the river. It is across this face of the big pile that the road runs, being open to the river view at all points

Facts About Concrete

How We Are Expanding Our Knowledge of the Behavior of Cements and Aggregates

By Robert G. Skerrett

TO many persons cement and concrete are synonymous terms There are thousands of our citizens, but little better informed, who think of concrete as nothing more complex than a casual mixture of cement, sand, broken stone or gravel, and water *ad libitum* And in practice, the latter conception is fairly widespread, if one can judge by the common use of concrete and the seemingly indifferent manner in which its several components are thrown together

Precious few of the public are aware of the exhaustive research that has been devoted in latter years to the intimate study of both cement and concrete; and these investigations have brought to light that concrete, especially, must be carefully compounded, appreciatively handled, and afterward given considerate treatment for a period of possibly weeks to make sure of obtaining the best results

Concrete in construction work has established its worth in numerous directions, but the material has also failed at times and caused much adverse criticism Broadly stated, most of these unsatisfactory showings have been due to preventable causes that may be fairly classed as ignorant procedure From now on these disappointments should be fewer with each year's applications, while, coincidently, we should find more and more ways in which to employ concrete structurally to our economic advantage Government and private laboratories have been engrossed with this subject for some time now, and facts of the utmost importance are being continually disclosed

For the sake of the uninformed, let it be said that cement is the product of some kinds of stone and clay, which have been ground fine and burned in a kiln to the point of incipient fusion, after which the clinker so obtained is thoroughly pulverized Simple as this sounds, Portland cement would not be what it is if its manufacture were not followed continually by the watchful and highly trained chemist Upon him rests the burden of selecting and proportioning the several constituents and then seeing to it that these are duly calcined and reduced to the powdery form familiar to most of us

As may be imagined the application of heat drives out the contained moisture in the raw materials, and one has only to add water to the cement to provoke a reaction which will cause the stuff to "set" and to become once more a petrified body Similarly when cement is mixed properly with the right measures of sand, gravel or stone, and water, the combination is intimately bound together in a few days and grows as hard as a rock Further, the concrete may even prove superior in divers respects to some stone formations of nature's own making. But before we take up concrete let us consider some of the things about cement which the laboratory has revealed to us of late.

The chemist and the research engineer have joined hands to deal with cement scientifically, and they have devised apparatus and methods for its testing so that they can specify with certainty what the material should be able to do if correctly made and treated in service. Every up-to-date producer of Portland cement in this country is profiting by these facilities and the standards so prescribed. Nothing is now left to guesswork Ingenious instruments are employed to ascertain the specific gravity, the fineness, the normal consistency, the soundness the time of setting, and the tensile strength of the dry cement, cement pastes, and mortars, respectively And then, the studies embrace what happens to sample briquets and test pieces in storage under circumstances approximating those of practical application

For years, the manufacturers of cement did not realize that their commodity might be modified to advantage by pulverizing the slag to a greater degree of fineness Today, after protracted inquiry, it is known that the fineness of cement has a decided bearing upon the strength of the concrete made with it The Government experts have reported that concrete made of the so-called fine cement was regularly and consistently stronger than concrete made of the somewhat coarser cement In meeting the requirements of a given job, the finer cement permits a saving of from 1.2 to 2.1 bags of cement for each cubic yard of concrete Again, another investigator finds that the finer grinding of the cement quickens the setting of the mixture and hastens the hardening of the concrete, results that might be very desirable at times

From the popular point of view, it might be thought, and not unreasonably, that the dominating factor in a satisfactory concrete batch would be the amount of cement used Curiously, on the other hand, we are informed that the measure of *water more often than otherwise* is the thing that either makes or mars the physical value of the aggregation. The methods of proportioning concrete which have been proposed in the past have failed to give proper attention to the water content of the mix. Experimental work has emphasized the importance of water in concrete mixtures, and shown that the water is, in fact, the most important ingredient, since very small variations in water content produce more important variations in the strength and other properties of concrete than similar changes in the

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An example of the use of concrete in a large engineering undertaking, where the material has to be counted on for permanence

Concrete floors of the sort here shown can be put up with confidence only as a result of exhaustive investigations of Government experts

Left: Aviator standing out on the plane and holding on to one of the struts, just before the parachute jump Note how the parachute is pulling on the shoulder straps *Center:* The Irving parachute closed, showing how the pulling of the ring pulls out the pins that hold the bag closed *Right.* The Irving parachute opened up just after landing

Details of the Irving parachute and how it is used in descending from airplanes while in flight

Making the Airplane Fireproof

OF the several dangers that confront the active airman, the one which he dreads the most is fire in midair The airplane, as generally built, is a highly inflammable structure, especially with its many gallons of highly inflammable gasoline From time to time there have been reports of special fireproofing compounds being developed for protecting the usual airplane construction, but it has remained for Parker R Bradley of New York City to perfect this form of protection and to demonstrate its practicability before flying club officials and others

Mr Bradley has spent nearly thirty years inventing and *developing waterproof fabrics and making* waterproof mixtures and dopes, the raw material in almost every case being nitro cellulose Several large industries have been established under his supervision to manufacture the products which he has invented In fact, Mr Bradley is the inventor of artificial leather, pantasote, keratol and artificial rubber All of which is by way of introducing his present work

The fireproof airplane which was used in demonstrating Mr Bradley's system of fireproofing was made super-fireproof, so to speak, in order to withstand almost any degree of heat and flame that might be applied to it in numerous tests Not only were the wings and other doped subjects sprayed with gasoline and ignited, but large quantities of all kinds of fireworks were attached to wing surfaces and other vulnerable parts and repeatedly ignited while in flight without damage to the airplane and with perfect safety for the pilots

However, for ordinary commercial and military purposes such super-fireproofing would be unnecessary Fires in the air or on the ground do not as a general rule, commence with a conflagration, such as made in the tests, but from small quantities of ignited oil and gasoline These being on fireproofed surfaces could not spread and would quickly burn out

Completed airplanes can be fireproofed only by removing all doped fabrics and recovering them by the new Bradley process The existing tank must be replaced by a specially designed *leakproof, fireproof,* heatproof tank Such a tank we are told, will not explode, ignite or burst on crashing No fireproofing could withstand the bursting of the gasoline tank in a crash for the reason that in the wreck the woodwork would be shattered and exposed to the action of fire, the fireproof protection having been broken through.

Aside from fireproofing the airplane, Mr. Bradley has devised a fireproof suit for aviators, which is shown in one of our illustrations This suit consists of a helmet, coat and trousers The helmet is made of sheet aluminum covered with a ⅝-inch layer of hair felt painted with three coats of the Bradley fireproof paint. Attached to the bottom of the helmet is a skirt of cloth, fireproofed by the Bradley process, which is tucked inside the suit proper Air is forced into the helmet by means of a pipe which has its open end in the propeller blast and exhausted from the helmet through a second pipe The exhaust pipe has a gauze-covered end which pre-

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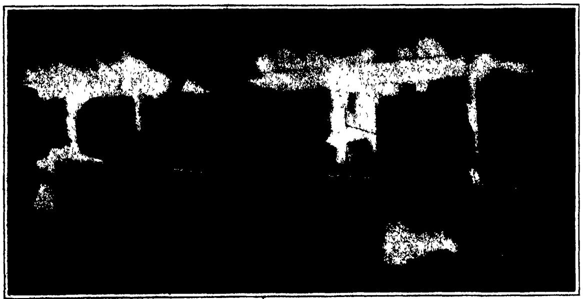
An aviator's fireproof suit, consisting of an asbestos suit and aluminum helmet



Testing an airplane of the usual construction which has been treated with the new fireproof paint. The wings have been saturated with gasoline and then ignited

An Airplane Parachute That Is Safe

THE Irving parachute, recently adopted by the United States Army, has been the object of experimentation by Mark M Campbell of Venice, Cal, during the past few months Campbell's work has been unique in the field of aircraft, for while others have been studying airplane and dirigible improvement, this man has been pioneering in the field of parachute work as applied to aircraft as a safety measure He is said to be the only civilian permitted to work with the Irving parachute

The new parachute, devised to work without fail when called upon has never yet refused to open in all *of the Campbell experiments These number into the* thousands and include tests at all elevations, under every imaginable wind condition, and with the parachute handicapped in every way the ingenious young aviator could devise

The principal feature of the new device is a supplementary umbrella which is attached above the top of the parachute This tiny umbrella has, as its function, the opening of the parachute The flier carries the parachute packed in a canvas case on his back A ring hangs over his shoulder and to the cord which is attached to this ring are fastened the pins which hold the canvas case shut

In an emergency the aviator simply pulls the ring This pulls out the pins and lets the case open The little umbrella is on top Its spring ribs instantly force it open and as it flies back in the wind, it pulls the top of the parachute along thus preventing any chance of the parachute getting tangled up or not opening Before the aviator lets go, his chute is open and all he has to do is step off and descend in the parachute The chute is strapped to him and his hands are free

For exhibitions, the jumper goes out on to the wing of the plane, opens the chute, and lets it pull him off In an emergency, the pilot of a stalled or burning plane stands up in the pit and pulls the ring The chute, opening in the wind, lifts him right out of the compartment into the air

Either as a safety device or as an exhibition affair, the new *parachute* seems to be as near "sure fire" and safe as is humanly possible With that much established young Campbell is continuing his pioneering efforts with a view to establishing a system for the control of direction and landing in a parachute The results will be interesting to watch

Another Giant Italian Plane

FROM Turin it is reported that another Italian constructor, this time Signor Ricci, is completing a huge machine The Ricci machine, unlike the ill-fated Caproni, is stated to be a quadruplane, with a total horsepower of 5,000 and a wing area of 8,000 square feet The machine is designed to carry 130 passengers, and the estimated speed is about 90 miles per hour The useful load is given as 20 tons

Brief Fallacies About Money

An Attempt to Refute Some of the Ideas on Which Satisfaction with the Present System Rests

By Charles E. Duryea

IN our issue of March 12th we gave Mr Duryea space in which to present his views as to what is the matter with our money system At the moment we were not, ourselves, absolutely convinced that anything was the matter with it, but Mr. Duryea's argument impressed us as decidedly interesting, and as possessing enough inherent plausibility to justify our giving it a place. It will be remembered that we did this, however, with the editorial fingers crossed, to the extent that we washed our hands of all controversy by putting this off upon Mr. Duryea. Mr. Duryea has had controversy as a result of his article, and plenty of it. We have seen some of the letters he received, and have read them with interest. As a result of the reception of his first article, Mr. Duryea has prepared a second, and has asked us to find space for it. Almost at the same moment, we picked up our morning paper and read the exposures in connection with the New York investigation into the building situation It appears fairly evident that when the people who have money to loan can lend a builder $9,000, and collect interest on $15,000, and collect $15,000 on maturity of the loan, and when the builder has to accept these terms or none, the statement that there is a money trust and that its operations are harmful is altogether within the facts We can think of no more timely circumstances for the appearance of Mr. Duryea's second article than on the wake of this exposure, so we hasten to put it in our first available issue.—
THE EDITOR.

WITHOUT proper diagnosis correct treatment is unlikely if not impossible This medical maxim applies with equal force to our politic and economic bodies The great facilitator of business is Money But when we need money most we find it hardest to get We know that our financial system lacks the flexibility it ought to possess to serve our needs but we content ourselves that it is better than formerly and *do not seek to carry it to perfection* We too readily assume that "it has always been thus and always will be" Believing that this and other fallacies are truths and that improvement cannot be had, our business men suffer in silence and wait for time to reduce our condition to a level where our faulty money does suffice They recognize we are losing millions of dollars in time, profits and turmoil but due to faulty teachers and leaders they think nothing can be done They should wake up

A half truth is the most dangerous doctrine because its fallacy works under the shelter of its truth and does great damage unobserved Our money system is thus cursed Although simple in basic principles, it is so often rendered confusing by those who attempt to expound it, that students give up in despair Few business men understand the facts and fallacies about money and we all suffer needlessly Let us examine them There are four fallacies of leading and most damaging type viz, the "has always been," the psychologic, the quantity theory and the interest rate

With few exceptions which *must be neglected in a* brief summary, money has always been scarce, too scarce *to* permit doing the business that could have been developed, it has ever sought hiding in time of crisis and been very slow about reappearing it has fluctuated in value—purchasing power—both as its materials—gold and silver—fluctuated and inversely as other commodities were scarce or plentiful and has been ever dependent on the accident of mining or conquest as to its amount "Can these things be changed? Not likely" Such is the belief of the average man and such was his belief as to autos and flying machines some years ago But mechanics knew better and will readily understand that the ancient invention—money—has been improved Paper money is that improvement, and it now rules the money market

So much better is it than metal money that even though our own nation has an unprecedented quantity of gold we do not use gold money So much better is paper that even a thousand years ago, Bank of Venice money, unredeemable paper, commanded a premium of 30 per cent often for long periods and in spite of usury laws We finished the Civil War on paper money Our Supreme Court in 1880 established its standing as proper and lawful money Since then we have been using it *more and gold less* The World War completed the process and placed the more developed nations on a paper basis *for all time to come* Now we are in a position to adopt money legislation that will meet our needs fully The Federal Reserve and Farm Loan Acts were big steps to that end We must extend them

"But," says the well informed skeptic, "money alone will not fix our troubles In boom times we overproduce and then must shut down until consumption catches up So we will ever have booms and panics We cannot change the psychology of humans" Partly true but mostly wrong We can do even that The fire drill has saved many a group of school children that without would have been piled in a heap on the stairs by maniacal mob psychology Stabilized money will stabilize prices and measure needs by actualities instead of by fickle, fluctuating daily quotations Low interest will permit carrying stocks until conditions require them and both will make business a certainty with low profits and few risks instead of a gamble by men who must profiteer to fortify against loss. A right money system will furnish conditions so dependable that psychology will cease to enter in the determination of values

Again the student of an age that has gone arises and says: "But low interest money, right off the printing press, would soon be of such quantity as to have no value Look at Russia! Look at all the European countries!" "Every child knows that the more there is *of a thing the less its value*" Sounds like truth indeed But is it? No! The Quantity Theory does not apply to properly issued paper money and postage stamps It does apply to commodities and to money which gets its value by being made of a commodity, like gold money. Increase the amount of gold and the value of gold falls both in the arts and as money Issue paper money which displaces gold and the effect is the same as finding more gold. We long ago passed that point When we issue paper money now we need gold for reserve or "cover" This tends to raise its value rather than the reverse

Since the Quantity Theory applies to commodities, their price and consequently the apparent purchasing power of money is affected inversely by their quantity This must not be forgotten During the war we paid much money to workers for war goods and made fewer peace goods They used that money to buy the few peace goods and bid prices up. A scarcity of peace goods, profiteering and such *things, and* not the quantity of money sent prices up Our paper money did not depreciate It still buys the *usual and* legal amount of gold Few recognize this We received much gold from abroad and this cheapened gold This also sent up prices as we have found out in everyday life

Having learned that shortage of peace goods was the cause of high prices we see that we should have produced more goods—not restricted our money But this is off the subject. "What is 'properly issued paper money' and how much may and should be issued?" Sufficient to meet the needs of business without commanding premiums, commissions, or high interest rates and *never* more than can be redeemed on presentation *in some commodity of* the stated face value. Certain redemption is the wall of protection against depreciation. No man, knowing that he can get the agreed value of his dollar by presenting it at a window, will take less Now will he? Certainly not. Nor does he care how many others exist The only essential for sound paper money therefore is *certain redemption.* Postage stamps never go below par although the vaults may be full of them and they have no "cover" except the mail-carrying facilities But let Uncle Sam stop redeeming them by carrying our mail and they at once become valueless How can any one deny these simple things?

"But how can Government redeem a great volume of money in gold?" Perhaps it cannot. Nor does it need to We formerly redeemed in both gold and silver. But at a fixed ratio. That was wrong. We must give Government the option to redeem in gold or in any stable commodity in such ratio as exists in the open market that day of redemption Most of us after the war found Uncle Sam would *give* us better value for our dollars in canned beef and similar things than we could get at the usual stores. That was redemption of paper money. State the value of the paper in terms of gold and redeem in many things of the same value This settles for all time the doubts about redemption It permits nations which do not produce gold to keep their money on a gold basis. Sooner or later it must be done. We need it now

Our most damaging fallacy relates to interest Learned professors, suffering from their own theories, tell us people will not save unless they can lend at high interest (But thousands do save and hide their money.) That interest represents self-denial of present spending in the hope of larger future spending. (But many wealthy deny themselves nothing and still have money to lend.) That the rate is a matter of supply and demand, but the Controller of the Currency says (Vol. 1, 1920 report, pp. 79 and 87, "renewal rates are artificially fixed daily by small coteries in secret meeting" and that these rates are "highest in the world," "unjustifiable," "cause of exorbitant rates for new capital," "and for huge shrinkage for all security values" Clearly professors err. Space limits further showing.

Here are two examples every mechanic can understand A city needing a market house and wishing to save interest, agreed to pay for the labor and material by issuing its promises to pay without interest, and by agreement of its people to accept those promises as money until the taxes and rental receipts could redeem them It worked. The people gained and *only* the money lenders lost. Another A maker of seasonable goods requiring skilled men had not capital to continue producing during the dull season. The goods were safe security for a reasonable loan but the time had to be longer than 90 days and the thought that foreclosure would likely follow failure to pay "on the day" precluded a bank loan. So men skilled by a season of training, had to be laid off Their families suffered while they, with less courage than before, sought another job. Those remaining were also affected and their output decreased perhaps 50 per cent. Overhead had to be redistributed with resultant increased prices and lessened business. When the days came that the goods could be sold, then began a rush to get and train more men and try to win back the position of a half year before. The struggle should have been to move forward from that advanced position. The final result was failure. The cause reported was "too little capital." Workers, both bosses and men know this is no fancy picture but is a continuous tragedy. Yet how easily remedied. If this maker could have applied to a government institution and received on presentation of ample security, such a loan as he needed for such time as he desired, at 1 or 2 per cent interest, he could have kept his shop running, his men enthusiastic, busy and happy and all adding to the prosperity of the community. When he sold his goods he would have returned the borrowed money and it could have been canceled.

Nor is there any danger of inflation by such a process. Every dollar loaned a producer puts far more than its value in goods on the market. Every such loan would be secured and redeemed by the borrower so Government credit would be benefited rather than injured. We have learned that streets and roads should be free; and that the mails should be carried at cost It is time for us to learn that money is even more a public utility than those things and should be so handled that one having fixed wealth can convert a safe portion of it into liquid wealth for the benefit of all. Our only hope to avoid being swamped by the low wage and low exchange products of Europe is to give our producers easy money at long time and low interest. We should do this before competitors take the markets of the world away from us.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

The Unit of Values

To the Editor of the Scientific American:

We have various units of measurements, weights and capacities. We are not satisfied with anything short of perfection in these units. The unit of length was for years a platinum bar and the scientific and business world was so careful of this unit that it was kept in an underground vault in Paris and was inspected only once in ten years We think this great care justified Our standard unit of values should also be put on a scientific basis. The platinum bar never varied a fraction in length Should not our unit of value be just as reliable? Fred Nihart

Homedale, Idaho

Millions and Billions

To the Editor of the Scientific American

An appeal for the amended use of the word "billion" In American journals it is commonly used to signify a thousand millions But that is not its etymological meaning. A million is the unit The second power is a billion, the third a trillion, the fourth a quadrillion, etc A billion is therefore a million millions.

It is not necessary to question the right of any persons to make the word mean what they please, but to call a thousand millions a "billion' is to misappropriate a word which has already a conflicting signification It is therefore certain to lead, as it is already leading, to practical inconvenience In a recent number of the Scientific American, the first article was a brilliant discussion of astronomical distances using the word for a million millions In the same number was an important article on the lumber trade in which the word meant a thousand millions Experienced readers soon grasp the intended sense, but others must be quite at sea.

If billion is used for a thousand million, what word will you use for a million millions?

Of course if "billion" is limited to its correct meaning the language will be in need of a word to express a thousand millions That number is not in the "million" but in the "mil" series It is the third power of a thousand, and the word "trille" or 'tril" would be correct It is respectfully submitted for consideration J M Buckland

Johannesburg, S A.

[It seems to us entirely a question of usage whether as Mr. Buckland says, the million or the thousand be the "unit" In the former case his claim is correct, in the latter the recognized American usage is justified We should think it more logical to take as "unit" the first number which requires pointing off of a "period" of three ciphers—The Editor.]

A War Memorial Suggestion

To the Editor of the Scientific American

While reading your interesting illustrated article on the proposed bridge over the Hudson River it occurred to me to suggest:

1 That it be called The Memorial Bridge,

2 That the partition between the foot passenger way and the trolley track be made of bronze in tablet form adequate to receive the names of all of our immortal dead who gave their lives for the welfare of humanity in the World War

Each state and territory could be allotted to it the tablet space required to enroll its heroes The ensemble to be under the direction of the bridge architect Each state and territory could, under specifications, furnish its tablet or tablets with the names of its soldier and sailor dead engraved thereon, of course in strict harmony with the general design of the memorial architects

The advantages of this memorial scheme are many

(a) The space is so ample that the dead could have expressed their divisional, regimental and company connections

(b) This memorial would represent the nation's unity of effort made by our soldiers and sailors in humanity's behalf

(c) Their one great purpose would be set forth by the one great memorial

(d) It would honor each *individually* and yet,

(e) It would associate them forever as comrades in death James Sharon MacCoy

Yonkers, N Y

Danger in Garage Pits

To the Editor of the Scientific American

I have noticed in your issue, dated May 14, that on page 393 there is a highly dangerous suggestion in regard to open pits for automobile repairing in garages Owing to the fact that gasoline vapor is heavier than air, it always seeks a lower level and collects in any pits and holes available, where it awaits the first accidental spark, carelessly thrown match, or other flame Experience has shown that the necessary accident to cause an explosion always arrives sooner or later, and the use of garage pits has consequently been prohibited in a number of cities, including New York City and Newark Before this prohibition went into effect one pit explosion was caused by the slight spark struck between a wrench and a rusty nut on which it was being used These explosions aside from their general hazard, almost inevitably result in the death of the mechanic who is in the pit at the time I trust you will place this danger before your readers with the same prominence given the original article

New York W E Mallalieu

Rifle Velocity

To the Editor of the Scientific American

On page 408 of the issue of May 21, 1921, in discussing the star Betelguese, the statement is made that the maximum velocity of the modern rifle is 2,800 foot second The writer of that article may know something about popular astronomy, and, incidentally, about Betelguese, but he knows nothing about modern rifles What about the Savage bolt rifle of 1920, 3,000-250? What about the present U S Service rifle? What about many others of American and foreign make all exceeding 2,800 feet per second?

Courtland, Cal W J Alexander

[The writer of the article in question gave 2,800 foot-seconds as a fair average velocity, not as a maximum velocity—Editor]

Red Rust in Hot Water Pipes and the Cause

ALL housekeepers are familiar with the appearance of red rust in hot water pipes but the actual cause of this is not generally known A Boston professor recently discussed this before the New England Water Works Association and stated that the common theory has been for many years that rust was formed by the direct union of the oxygen and the air, water and air, but this is now proved not to be the case. In order to form rust the iron must actually go into solution in the water, he says. If oxygen is present it unites with this dissolved iron and separates out as red rust. When the iron dissolves in water an equivalent amount of hydrogen is set free as gas and forms a protective coating on the iron, but if oxygen is present in the water it unites with the hydrogen and the protection is removed Where there is a complete absence of oxygen in the water no appreciable corrosion will take place. The action of all the factors causing corrosion is accelerated by rise in temperature; hence a hot-water supply system in which hot water fully charged with atmospheric oxygen is constantly passing is a most vulnerable structure. Since oxygen is consumed in the formation of rust, it follows that if water is held in contact with iron it will lose its dissolved oxygen and become inactive. It is on this principle that "deactivisers" have been introduced. In a Boston apartment house with large central-heating equipment, the method adopted was to pass the water from the street main into a heater where its temperature was raised to 160°F, It was then passed through a storage tank containing iron sheets that had been chemically treated so as to cause rapid corrosion, and finally through a filter which prevented the red rust formed from passing into the heating system.

A New Dental Anesthetic

A COAL-TAR chemical for the elimination of all pain in dental surgical operations, simple of application and suitable for repeated and universal use in oral surgery, is announced by Dr. Joseph A. Klein of New York City.

This new chemical is liquid in form, is applied on a pellet of cotton to the gum or mucous membrane surrounding the tooth to be anesthetised or into a cavity prior to excavation where a tooth is to be filled or treated. It produces complete local anesthesia in from two to eight minutes, and eliminates all feeling for from one to six hours

Dr Klein has extracted teeth and pulps painlessly by the use of this chemical Its effect is entirely local, so it may be applied with perfect safety, regardless of the patient's age or general physical condition, and it is particularly valuable as an anesthetic in the extraction of children's teeth It leaves no disagreeable after-effect, but because of its long period of activity gives the nervous system ample time to recover from the shock of operation before the nerves in the area of operation regain their normal feeling or activity

Paper Salvaging in the St. Louis Public Schools

THE excellent work done by the public schools of St Louis in salvaging waste paper during the school year 1919-20 was described by former Secretary of Commerce Alexander in *Commerce Reports* That this campaign was not only being sustained during the past year, but was accomplishing remarkable results, is evidenced in the following data furnished by the assistant superintendent of schools for St Louis on November 22, 1920:

Pupils in the St. Louis public schools collected and brought to school 494,181 pounds of waste paper during the first quarter which ended recently This amount represents an average contribution of 4.91 pounds for each of the 100,000 children now attending the public schools If the rate established during the first quarter is maintained for the balance of the year, approximately 2,000,000 lbs. of paper will be salvaged

During the week of October 17-22 more than 35 tons of old newspapers and magazines were collected by 100,000 pupils in 185 public schools, according to Stephen M Wagner, chairman of the public school thrift committee This amount is the largest collected during any one week since the waste-paper-saving movement started in the schools several years ago, and represents a value of $1,211.40 at present prices paid for waste paper. Receipts for the year are expected to exceed greatly those of last year, when a net profit of $17,308 was realized from the sale of 858 tons.

A 5-ton automobile truck has been purchased by the association to take care of the increased paper collections This will replace a 2½-ton truck, which has been found inadequate for the business.

Saving paper has become a regular part of a well-planned system of education for thrift in the St Louis public schools, and the children are taught that a great many things that heretofore were thrown away can be made use of and be of real value The proceeds of this work are credited to the Teachers' Benevolent Annuity Association, an organization of teachers formed for the purpose of aiding those who retire after long service and of relieving members temporarily in need

Fire Proofing Wood

THE Technical Notes of the Forest Products Laboratory report some progress in the preparation of fire retarding paints as the most practical means of making small amounts of wood somewhat fire resistant. Older methods of impregnating the wood with chemicals under pressure or means of keeping it moist are usually too expensive for small projects although they are more effective It is interesting to find that the ordinary white wash or calcimine has proved to be as satisfactory as any other type of paint A coat of calcimine will not prevent the burning of the wood if exposed continuously to great heat but it does materially decrease the danger of a blaze spreading from sparks, cigarettes, and other small sources of fire Calcimine is naturally best suited to inside uses For outside work the Laboratory has developed a coat which consists of zinc borate and chrome green ground in linseed oil This paint after three years of exposure to the weather has retained its fire resisting properties.

Transmutation of Elements

DR CHARLES BENSON DAVIS of New York City claims in a paper which he has prepared and submitted to Engineering Foundation, that he can make and has made some of the chemical elements, such as gold, silver, platinum and copper by transmutation of a common element He has shown samples of the metals he claims to have made to members of the Engineering Foundation in New York City, and has requested that body to investigate his claims and his methods. Dr Davis is a reputable chemist, a member of the Society of Chemical Industry, a Fellow of the British Chemical Society, and an honorary member of the Société Académique d'Histoire Internationale He is the author of several papers which have been published in chemical journals

The Craters of the Moon

Possible Light on Their Origin from Experiments with Airplane Bombs at Langley Field

By J. F. Springer

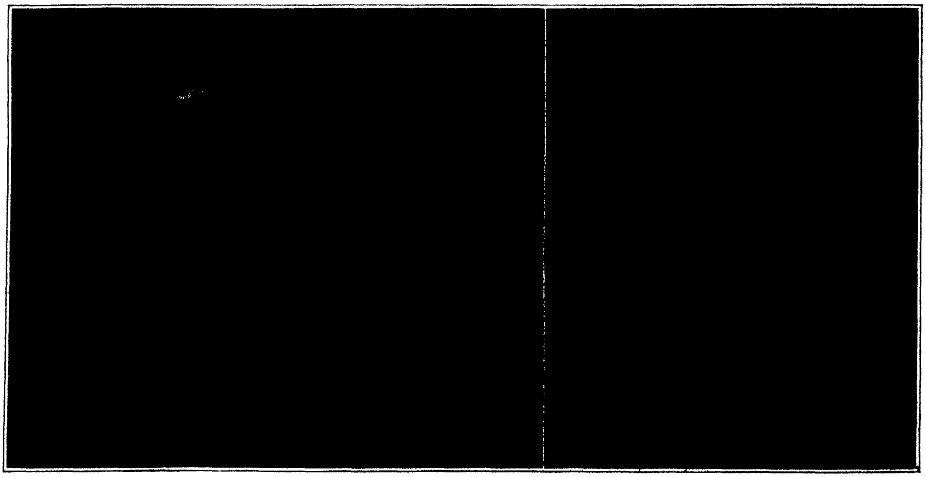
A bomb crater so large that it took twenty men to span it

THE moon is our nearest celestial neighbor, being only sixty terrestrial radii distant Markings on its surface are plainly visible to the naked eye In the field of the large telescopes these markings assume, many of them, quite definite forms Thus, a large proportion resemble more or less closely volcanic craters on the surface of the earth It has been held pretty generally that depressions of this description on the lunar surface are really the result of volcanic action But more recently a rival hypothesis has arisen In accordance with it, the crater like formations are the result of the impact and penetration of meteoric bodies Which is the true hypothesis, if we exclude further alternatives? The present article gives certain recent evidence in favor of the meteoric hypothesis this evidence having been brought forward by Maj Herbert E Ives late of the Aviation Service This evidence is the result of experiments carried out for military purposes on Langley Field The effort of the military authorities was directed to the purpose of getting definite and reliable information of the effect of dropping bombs from airplanes Photographs shown herewith disclose bomb-formed depressions markedly like those found on the moon It is thought that the depressions made on Langley Field are of exceptional value because of their considerable size, outranking in this respect other experiments previously carried out with the view of noting the effects of impact Thus, the depressions on Langley Field run up to craters of such size as to require for spanning the opening a line of 20 men with *hands joined* Of course, the lunar craters run up to much greater sizes Ten, twenty and even sixty miles represent diameters of actual depressions on the surface of the moon The earlier experiments may be suitably classed as laboratory, in contrast to the results produced on Langley Field

That there has been and perhaps is still volcanic activity on the moon may be supported by certain facts The name Plato has been given to a very large lunar crater 60 miles in diameter The floor is a plain on which are scattered a considerable number of small conical piles Some of these have a diameter of only a few hundred feet, others of as much as a mile British astronomers mapped the crater floor shortly after the close of our Civil War, thus accurately locating 36 of the cones About 1881 four British astronomers worked out another map showing 38, and in 1892, Prof W H Pickering made a map on which 42 were located A comparison of the three maps shows that only four cones are common to all Changes in brilliancy and complete disappearances were disclosed by Professor Pickering's studies in 1892 Altogether, there is pretty good evidence that Plato was by no means inactive in the period 1870-1892

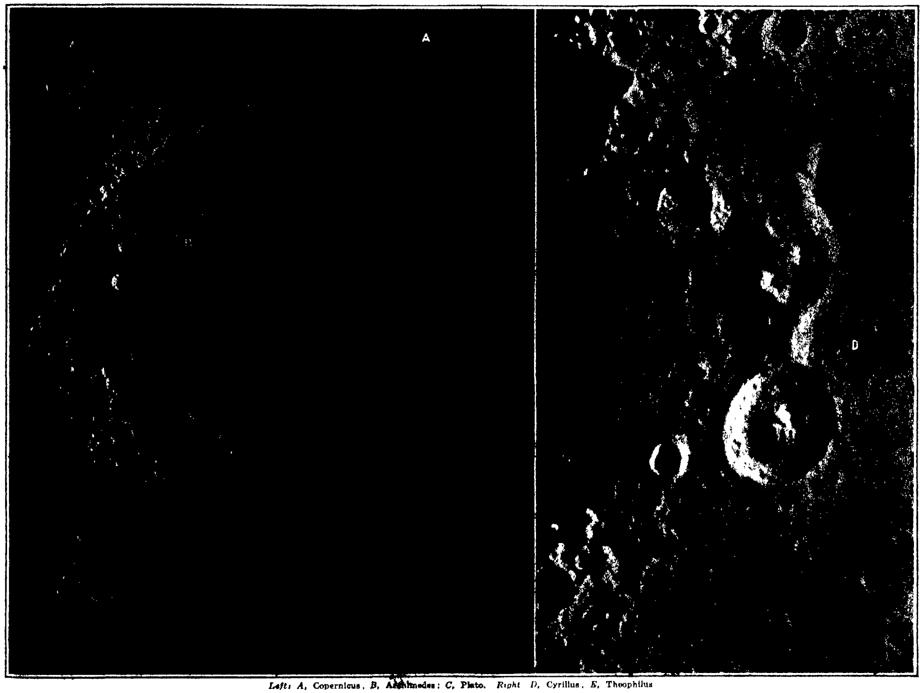
A representative lunar crater will have its floor at a lower level than the land of the neighborhood This contrasts with terrestrial craters in general Often a lunar crater will disclose no central peak and the amount of material in the surrounding ridge is less than with us. However, Professor Pickering finds that Hawaiian craters approximate more or less closely those of the moon Kilauea and Mauna Loa, both on the Island of Hawaii, have crater floors of considerable size from which rise circular enveloping cliffs varying from 500 to 1,000 feet in height There are no very tall volcanic cones on them These and other points create a considerable list of resemblances to lunar craters The crater floors are, however, higher than the neighboring sea level But Professor Pickering calls attention to the *fact that the exterior sides of these volcanoes slope* so gently that if many such mountain forms were grouped together, the general surface would be decidedly higher than the crater floors As to size, the two or three miles of diameter of the Hawaiian craters are very much smaller than numerous, very numerous, diametrical measurements across the lunar craters. However, if allowance be made for the difference in gravitation, it is permissible to expect the moon's craters to have about six times the diametrical size of those on the earth The "two or three miles" then becomes in effect twelve or eighteen miles Even so, we are short of such big craters as Plato However, there are on the surface of the earth three craters having a diameter of about fifteen miles One is located in northern Kamchatka, another is Mt. Asosan in the Japanese Island of Kiushiu, and the third is Lake Bombon and its surroundings on the Island of Luzon, Philippines Altogether a formidable array of evidence may be piled up in favor of the volcanic origin of the craters on the moon

As far back as 1873, the astronomer Proctor sug-



Left: Large bomb crater, showing central elevation and radiating streaks like Copernicus, and overlapping craters strongly suggestive of Theophilus and Cyrillus. ***Right:*** Large crater with flat central plane, smaller one with central peak, very like some of the moon's mountains

Impact craters from Texas that closely resemble the big pits observed on the surface of the moon



Left: *A,* Copernicus, *B,* Archimedes; *C,* Plato. *Right* *D,* Cyrillus, *E,* Theophilus

Two views, one of the moon's northern limb and the other of a smaller region, showing craters that could very well have been produced by impact

gested the meteoric theory. The objection has been raised to this conception that meteors of sufficient size that would approach the moon at rates of speed comparable with those of the planets would do too much. The planetary bodies move, it must be confessed, at some speed. Thus, the orbital rate of the earth is in the neighborhood of 18.5 miles a second. A big meteor coming in on the moon at a terrific speed would, by its impact and sudden stoppage, melt itself, any crater walls that might form, and even a ring of the surrounding country. If the meteor struck obliquely, the crater—allowing that a permanent one would be formed—would not be circular but of an elongated form. But the lunar craters show a general perversity in adopting for themselves the form of a circle. However, if we are to regard the moon as originally derived from the earth in the form of fragments, then these objections may be pretty well removed. In the first place, the fragments falling on to the general mass would not be moving relatively to that mass with anything like the rapidity of planetary bodies. The excessive amount of heat upon impact and stoppage is thus eliminated. Further, it seems that these fragments falling in on the central mass would direct their motions toward its center, and would consequently create circular depressions.

One investigator (Gilbert) dropped globules of water on to the surface of thin mud and produced craters with enveloping walls and sometimes with central peaks. Dr. Bigelow of Boston fired pistol bullets into plaster of paris while it was hardening and Mr. R. S. Toser bombarded a clay surface with balls of the same material. Some of these clay craters turned out to be quite similar to those on the moon.

Now we have Maj. Ives and his craters of considerable size formed on Langley Field. He directs our attention to Copernicus, among others. This is one of the big fellows on the moon. There is the big circular depression with the surrounding ridge. The comparatively flat floor discloses several peaks rising from its surfce. In the neighborhood of Copernicus are several smaller craters, illustrative of depressions with and without a central peak. Archimedes and Plato are two other big lunar craters. They also have flat floors with surrounding rings. A comparison of these three craters with the cavities formed by impact on Langley Field will show similar features. We have the circular depression and the ring-like ridge. One of the crater floors shows what appear to be small peaks. The cause of the formation of these peaks may perhaps be attributed to some sort of a rebound. Lead bullets fired at a lead surface resulted in such peaks, in certain instances, at least. It seems that an early objection to the meteoric hypothesis centered on the difficulty in seeing how an impact would produce the small peaks. These have now been produced by dropping water, lead bullets, clay projectiles, and, last of all, military bombs. Whether, in the last case they are due to material which was at first ejected from the depression but which later fell back, is not easy to say.

When a punch or similar instrument is forced to make an indentation in a metallic surface, a ridge forms all round the hole. This is doubtless explicable upon the general basis of the impenetrability of matter. The material forced in must cause other material to move, even after one makes allowance for a measure of compression. The locus of least resistance is the region surrounding the punch and lying close up to it. Upon the hypothesis of the formation of the lunar craters by meteoric impact, the surrounding ridges are doubtless to be explained along the lines employed in giving a reason for the ridge around the punch.

The formation of the peaks under the impact hypothesis would seem to be not so very easy of explanation. If they are the results of initial compression followed by release, one wonders what combination of circumstances brings about concentrations of this release at various points and particularly at the center of the main region of impact. If the meteoric face presented cavities, the peaks could be explained after the manner of the surrounding ridge. But why a central peak? The dropping of globules of water upon thin mud, however, did in fact produce cases of a peak in the centers of the depressions, so that, it would seem, impacts may produce central peaks whether we understand the process or not.

An objection has been brought against the impact hypothesis which enters upon the physical property of plasticity. At ordinary temperatures, there are numerous substances which will bend and otherwise deform upon the slow application of physical forces, which will nevertheless fracture or crumble if the force is applied quickly. Thus, a long rod of glass, if supported in a horizontal position at the two ends, will bend under its own weight with the passage of time. In the course of a year or two, even this brittle material will have undergone a very considerable deflection without fracture. Doubtless, almost any of the usual materials may be made to "flow" if the compelling forces act slowly enough, and it is probably just as true generally that the speed of action may be increased, provided the temperature is properly raised. Now a meteor striking is not a slow force and one is accordingly to expect fractures and crumbling effects rather than a flow. On the other hand, it generates heat by the transformation of the physical motion through the impact. It may very well be then that the motion and the temperature may be sufficiently related to account for the ridges, depressions and peaks on the lunar surface. Besides, may not there

(*Continued on page 499*)

Cacti and Their Uses

A Discussion of This Interesting Family and Some of the Things It Is Good For

By Dr. William A. Murrill, New York Botanical Garden

Photographs by courtesy of the United States National Museum

A desert is not necessarily a monotonous waste

The splendid flower of Heliocereus Mallisoni

IT is estimated that there are three billion acres of desert land in the world, and, if these unattractive and unproductive wastes are ever to "blossom like the rose," it will be the cacti or plants similarly adapted to desert conditions that will furnish the flowers Desert plants were like other plants once, but the vital necessity for preserving moisture gradually wrought a wonderful change in their appearance and structure Few of the cacti now have any conspicuous leaves, their place being taken by flattened joints, or pads, which are modified portions of the stem, and even the sap has become mucilaginous or milky, preventing the loss of water to the hot, dry air by which these plants are continually surrounded Spines of various shapes and sizes serve to protect them against grazing animals that are often killed when driven by hunger and thirst to devour these plants in spite of their spines The few forms of spineless cacti that occur in the wild state always frequent rocky ledges and other situations that are inaccessible to most animals, if not to all

The number of species of cacti recognized is large, amounting to about one thousand, and half of these are found in Mexico. They vary from tiny plants no bigger than one's finger to trees sixty feet in height, presenting all manner of queer and interesting shapes and furnishing the botanist with no end of knotty problems Extensive collections of living plants may be seen under glass at the New York Botanical Garden, the Department of Agriculture in Washington, and the Missouri Botanical Garden in St Louis, while others in the open are to be found at Riverside, California, Tucson, Arizona, Mesilla Park, New Mexico; Laredo, Texas, Miami, Florida, and elsewhere

Cactus plants are certainly not ornamental in the ordinary sense, but beauty is relative A forest of giant cactus trees stretching mile after mile in the desert with nothing to rival them may be decidedly attractive In Mexico the cactus ornaments the national banner and is stamped on many of the older coins, while in Arizona and New Mexico it has been selected as the state flower.

The cactus family is noted for the magnificence of its flowers, which are usually large, often fragrant, widespreading or tubular, diurnal or nocturnal, evanescent or persistent, and vary in color from white, yellow, or orange to rose-colored, deep red, or purple The calyx and corolla are not distinct but the numerous stamens in the center are often differently colored and lend an added charm to the flower The fruit is often brilliantly colored, highly ornamental as well as useful, and lasts for a long time

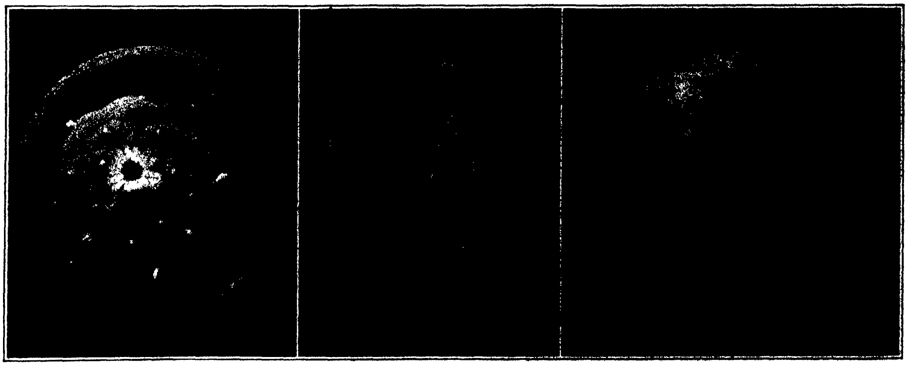
The cactus plant has indirectly added much to the attractiveness of certain manufactured garments by supporting the cochineal insect, from which the famous cochineal dye is made This insect occurs on a species of Opuntia, the cochineal fig, and its near relatives, along with other mites and scale-insects, but it is so minute and difficult to distinguish with the unaided eye that it was long thought to be the seed or bloom of the plant itself Leeuwenhöck, in 1708, discovered that it was the female of an insect (*Coccuc Cacti*), which never moved from a certain spot on the cactus, the male being the active member of the family but colorless and therefore useless These insects are harvested three times during the dry season, being swept from the cacti into wide mouthed bags with stiff brushes and killed in boiling water or hot ovens, after which they are dried in the sun and put up in small packages for the market In this thoroughly dried condition 70,000 insects are required to make a pound.

The ornamental value of cacti, although important, is not uppermost in the mind of the average inhabitant of arid regions The trunks furnish him material for houses, corrals, firewood, etc, and, when planted close together they form hedges that are lasting and impervious It is here behind a shield of thorns that the little cactus-wren finds a refuge from hawks where she can build her nest and rear her young in safety

The cactus trunk is composed of a woody axis, or skeleton, surrounded by pulp. From this skeleton table legs, chairs, napkin rings, canes, veneering, etc., are made The spines also are useful, serving as needles, toothpicks and pins for mending leather or cloth. Some are curved and supply ready-made fishhooks, while the straight ones are bound to slivers of bone to form very efficient barbs. One species of cactus bears fruits that resemble great chestnut burs, and these have been used by the Indians for ages as hair brushes.

The pulpy parts of the stems and fruits are highly valuable as food both for man and beast The young

(*Continued on page 499*)



Left: The mescal button, or peyote, in flower *Center:* A species of Opuntia from Kansas. *Right:* A rather curious species of Echinocactus found in Mexico

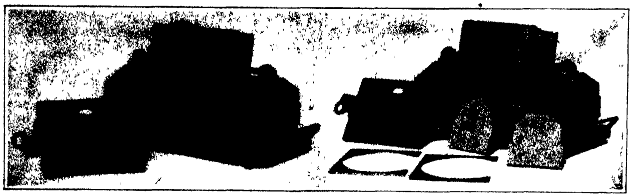
Several cacti of widely differing types

A Money-Saver in Locomotive Repair

EVERY steam locomotive carries from four to twenty-eight bearing boxes for the truck and driving wheels. Each of these boxes has a hubliner—a metal disk protecting the driving box from the friction of the wheel hub. This hubliner is ordinarily cast on from babbitt metal, by means of an operation that is difficult and dangerous for the machinist and inordinately costly to the railroad. The machinist has to raise the bearing box with a chain hoist and put it in a fire pot, where it must remain half an hour before becoming hot enough. When it attains this point it is again hoisted out of the fire and put on the floor, where a workman builds a wall inside and out of fire clay, large enough to cast on a two-inch liner. After some five hours the box has cooled sufficiently for it to be moved into the machine shop Here the babbitt is shaved off to the proper thickness, the shavings falling to the floor and mixing with the iron and steel scraps which lie there, making necessary a separating process before the latter can be used. The babbitt scrap is waste pure and simple, since a second heating renders it second class metal. After this planing the box is carried to the locomotive erecting shop, where the necessary holes are drilled for assembling it on the engine—a difficult task, and one invariably resulting in loss of one or more drills The entire process requires the services of five men and extends over two to three days

A Newark, N. J, machinist has devised a hubliner mold that eliminates all this It makes possible the installation of a hubliner within an hour and a half No heating, soldering or fireclaying is required. The lubricating holes are cast direct in the liner, saving all drilling. The liner can be cast right on the cold box at the point where it is taken from the wheel, so there is no chain-hoisting or other moving of the work about. Although cast on the cold box without soldering, the inventor guarantees that the liner will not come off. He points out that when cast this way the liner has a "skin," which is not the case where it has to be shaved off; the period of renewal becomes a year instead of six months

The apparatus by which all this improvement is attained is simple enough. Our photograph shows it after it has been taken down off the completed liner, which is seen as cast on the box. It will be at once understood how the pattern is clamped to the backpiece, and the latter turned over and clamped to the end of the box, preliminary to the casting Patterns of various shapes and sizes may be used with the single back-piece to produce liners of any desired model.



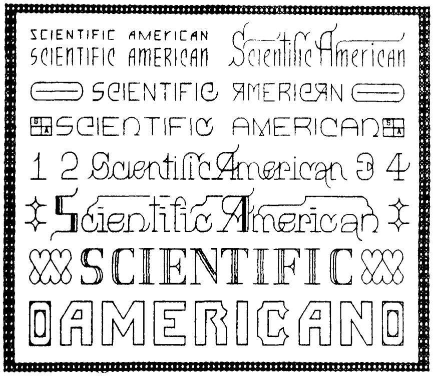
Left: The old method, showing how much metal was wasted. *Right:* A hubliner cast on the box by the new process, and the mold disassembled beneath

The new outfit for casting locomotive hubliners at great saving of men and metal

Ornamental Typewriting

AT the time, a year ago last fall, when the editorial typewriters kept the SCIENTIFIC AMERICAN in the ring while most of our contemporaries were suspended because of the compositors' and pressmen's strike, none of our readers was more interested in our efforts than Mr. Jacob Backes, of this city. Mr. Backes has for some years been interested in the possibilities of photographic reproduction from typewritten copy as an alternative for type-set material, and he has written several articles explaining his ideas, and even gone so far as to induce the Century dictionary to recognize the name, callitypy, which he has given to his system He boldly takes the bull by the horns in the matter of typewritten text, and insists that the only reason for having the lines come out with even words or syllables is convention, that it is just as sensible to carry a word over at any point Accordingly the difficulties of justification which we emphasized in our issue of December 13, 1919, do not exist for him—he runs merrily along and moves over to the beginning of the next line whenever his copy brings him to the end of this line

Mr Backes has recently been experimenting a little further in the direction of typewritten copy, and he now finds that he can produce title lines of various degrees of fancifulness with the one machine It will be recalled that when we were typewriting our issues we had a special machine for printing the main titles, and that we made subtitles and authors lines by using the capital letters on two ordinary machines of slightly different type face Mr Backes has found seven characters on the keyboard of his typewriter that can be dispensed with—we can count without any particular exercise of the imagination nine such characters on the machine which we are using at the moment, the very one it so happens that produced 95 per cent of our emergency issues of 1919 He has replaced these seven dispensables with seven arbitrary signs—a simple curved line in four positions, an upright of ordinary type thickness and one of solid black much thicker, and a diagonal line sloping backward Taking these seven in conjunction with the ordinary hyphen dash and diagonal fraction bar, he is able to execute a large variety of ornamental lettering The series of SCIENTIFIC AMERICAN titles which he has turned out bear ample witness to this, and a careful examination of these will make it clear that Mr Backes is justified in his claim that he has done no retouching or blocking out, and in fact no trick work whatever So far as the handling of the machine is concerned, this copy is evidently straight typewriting and the possibilities are doubtless considerably wider than this particular group of examples shows



THE letters, ornaments and borders in the above illustration were produced by typewriting the characters \ ) ((/ | _ \ ▌ - combinationally end to end or over each other. The callitypic outlineals took the place of as many dispensable characters on the machine. Ordinary black record ribbon was used, no carbon sheets. All typing proceeded from left to right. There was no penwork, whiting out or soldering or mortising. No guiding device was used, and there was no shifting or reinsertion of the paper.

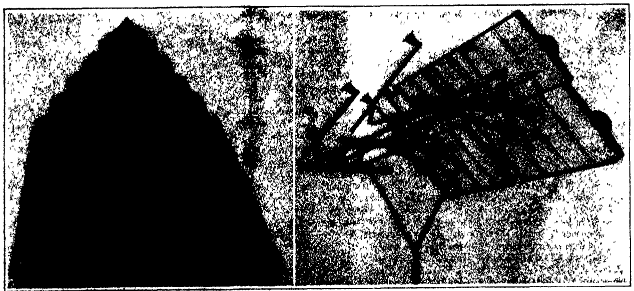
The original size of this callityped illustration was 8 1/5 by 7 inches. All originals can be either photographically enlarged or reduced to microscopic print.

A sample of what can be done with a typewriter equipped with a few special keys

A Weather-Proof Skylight Ventilator

SOMETHING different in skylights is the subject of the accompanying drawings—nothing less, in fact, than a skylight the entire area of which remains available for ventilation during any ordinary rain or snow storm The skylight is immediately self-opening when the control is released This control may be by hand, or if it is desired that the skylight open as a means of release of smoke and fumes from fire, it may be held in closed position by a fusible link or an inflammable rope, to be automatically released when this gives way The explanation that the new ventilator is designed largely for use in theaters explains what might otherwise be somewhat of a puzzle—why it is desired to give a fire exit to the outer air

The construction is such that the device can be used as a lean-to ventilator and skylight, or placed in any other way When closed, one sash overlaps the next by several inches, with a nosing at the top of the under sash to keep out any water that might be driven up by a rain storm



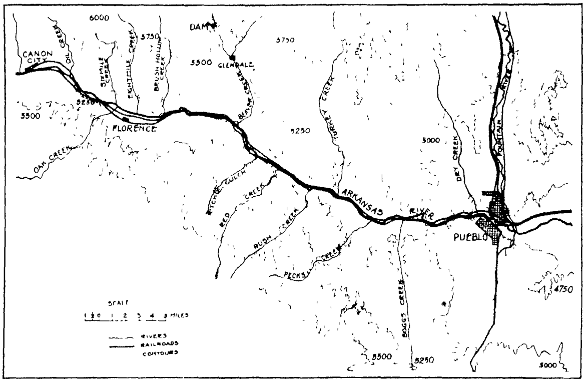
The automatic ventilating skylight, showing how it looks when open, and means for controlling it

Colorado's Cloud-Burst

Some of the Causes and Results of the Pueblo Flood

THE flood which ravaged eastern Colorado beginning *on the afternoon of* Saturday, June 4th, is of considerable interest from the scientific viewpoint The damage done, both to life and to property, was not so heavy as has been done by other floods The Johnstown disaster that cost 2,209 lives will hardly be *equaled by the Colorado floods*, *certainly no such toll* as the 6,000 killed by the Galveston hurricane will in the present instance be exacted The property loss will not reach the figure of $300,000,000 attained by the Miami flood of 1913—probably the most costly freak *of the weather, so far* as dollars and cents go, ever experienced in this country

Yet the Colorado flood of 1921 will perhaps take front rank in disasters strictly comparable to it in cause The Dayton catastrophe was hardly an "accident" at all—it was merely the annual rise always *to* be looked for in the Mississippi and its various tributaries, made higher than ever before by a combination of circumstances The Johnstown flood was directly due to human failure—the water that engulfed the city was *not that of a* sudden storm or of a natural increase in the river, but simply that stored in the big dam when this broke And the Galveston disaster was entirely different from all the others mentioned in that it was not the sequel of an over-burdened river at all, but was due *to no* other cause than the piling up upon the shore of the waters from the Gulf of Mexico, urged landward by continued high winds



The section of the Arkansas valley in which the Pueblo flood originated, showing the contour of the land and the location of railroads and chief towns

The water that descended upon Pueblo with so little warning, on the other hand, was neither a seasonal freshet nor primarily the store from behind a broken dam To a degree seldom if ever before approached by a destructive flood it was entirely the proceeds of a single violent downpour of rain The cloud-burst is *not* a common phenomenon—it occurs from time to time, and from place to place The weather man knows very well what it is, *but* why it is *he has not* yet been able to state to his complete satisfaction It is distinguished from cyclone, tornado, hurricane, etc, by *the fact that the outstanding* feature is precipitation rather than wind We may have a perfectly good cloud-burst with practically no wind—at least with practically no surface wind

The name appears to be a relic of the time when the clouds were thought to be *more* or less *substantial* and *continuous* masses of water suspended as such, in bulk over the earth, and when it was therefore possible to regard the sudden deluge of water as actually resulting from the "bursting" of such a mass—presumably much as a tire bursts when it blows out These violent storms are local—so much so that they can often be sufficiently placed by reference to a single town The chief difficulty in accounting for them lies in the fact that a great deal more water is precipitated by them than it would be possible for the entire atmosphere above their point of occurrence to hold, even at the point of absolute saturation Moisture-laden currents must therefore be brought in from other localities, and the suddenness and violence of the typical cloud-burst suggests that several such currents are required It also appears probable that the conditions for a cloud-burst involve an abnormally high temperature-altitude gradient, so that a comparatively slight rise of the air will result in a heavy drop in temperature and hence in the amount *of* water that the air can contain In any event, it is clear that the cloud-burst involves the laying down, all at once and in *one place*, of *moisture taken* up by the air over a large area and a considerable time

One who has not actually witnessed one of these affairs can have little conception of the violence with which it rains. "The skies opened" and "the rain came in sheets" are but feeble efforts at description. It is seldom that accurate measurement of these *torrential downpours can be made* Nevertheless, the general statement is offered by General Greely, the explorer and meteorologist, that while two and one-half inches in 24 hours constitutes an exceptionally heavy rainfall, the cloud-burst attains a rate of precipitation *of from five to eighteen inches of* water per *hour* In a word, a week's hard rain falls all at once

There are two factors which, given a cloud-burst, determine the degree of damage The water is there, it must be disposed of It may be absorbed by the ground, *and it may run off: other alternative* there *is not* The absorption depends upon the character of the soil To be sure, under such a bombardment of water as is offered by a severe cloud-burst, almost any soil might get saturated, but a thick surface layer of sandy or stony soil passes water through to the lower strata with surprising swiftness, and can take care of a surprising proportion of the deluge A dense, clayey cover, on the other hand, possesses very slight absorptive power to begin with, and as soon as this is used the clay soil is finished—it passes the water down through the ground with extreme slowness Everybody has seen soil of this character, so impervious to water that it doesn't even form mud, but allows the fluid to stand much as it would on a concrete slab

When the soil has absorbed what it can of a sudden downpour, the *rest* has *to* run off via the *streams* If these possess reasonably high banks for a considerable distance below the point of the cloud-burst all is well It is difficult to imagine for instance, a destructive flood along the Delaware River from Port Jervis to the Water Gap The surface of the *stream* could *rise* vertically twenty feet or more with practically no damage—even the river road is higher above the water than that, and the houses and villages are higher yet One would as soon expect the Colorado to overflow the banks of the Grand Canyon and flood the plains of Arizona, as the Delaware to do any material damage in this part of its course But all rivers do not flow through gorges and deep valleys The rivers that enter the Mississippi from the west in particular are of a sort not easily visualized by one accustomed to streams like the Delaware and the Hudson, the Susquehanna and the Connecticut, the Merrimac and the Penobscot. It is hardly any exaggeration to say that the Platte and the Arkansas, the Red and the Canadian, flow across the flat surface of the prairie, rather than in depressed beds A Nebraskan would laugh at the easterner who might refer to the "valley" of the Platte. A rise of a few feet in these streams involves a lateral spread out of all proportion to the vertical increase.

This is the sort of stream that was asked to carry off the water of a particularly severe cloud-burst. Through the Royal Gorge, just west of the left-hand edge of our map, the Arkansas is a regular mountain stream—the Gorge is 2,000 feet deep and might with good reason be called a canyon, as is attested by the name of the town at its mouth—Canyon City. But as we go downstream from this point, the banks become less and less steep and recede farther and farther from the stream. By the time we come to Pueblo, we have, at the south, low bluffs a mile or so from the river, with a flat between that is little if any above the level of ordinary high water. At the north there is not even the bluff—the flat is wider, and shades off almost imperceptibly into the hills.

On top of this the entire area covered by the rainfall has a surface of rock or of hard, impermeable clay. It is little exaggeration to say that every drop of water that fell had to make its way to the streams. The cloud-burst appears to have been in the mountains north of the Arkansas, and to have been one of exceptional severity The various creeks that are shown emptying into the river from the north appear to have moderately high banks This means that when asked to carry off a volume of water many times their capacity, they are able to meet the demand. Instead of spreading all over the surrounding territory, and then receding gradually over a period of days, they rise ten, twenty, thirty feet or even more, increase their rate of flow, and fill their gorges with a raging torrent of flood water. No damage is done because nobody to speak of lives along such a creek in the first place, and those who do live along it have their shanties at a reasonable elevation above the water

In the case of the present flood, there was another and a man-made complication. *Along* several of the creeks that run into the Arkansas there are dams, behind which are reservoirs with considerable storage capacities The one on Beaver Creek at the point indicated on the map burst, and to the already swollen waters of the creek was *added the contents of the* reservoir

It had been raining rather steadily all over Colorado for some days, and the creeks were *at a* very liberal stage to begin with, so was the Arkansas River The Fountain River, which rises not far from Denver and, in its southward course receives tributaries mostly from the west, draining the Pike's Peak section, was likewise pretty full The cloud-burst sent *a* wall *of* water many *feet in* height down Beaver Creek and many of the other streams flowing into the Arkansas and the Fountain This is another expression which we are more accustomed to meeting in fiction than in fact, but which does no injustice *to the facts* A sudden flood *in* one *of* these rock-bound creeks produces a wall of water rushing down the stream, just as truly as the bursting of the Johnstown dam released such a wall If only one of these creeks were to discharge its flood into the Arkansas, the excess water could be taken care of. But there were more than one, and the entire drainage system of the country already held the full volume of water that it is designed by nature to care for If the rate of flow attained by the narrow and steep creeks could be maintained in the rivers, the problem of disposing of the water would come close to solving itself. But the broader and more gently sloping river is of necessity a stagnant pool, in comparison with the creek; excellent illustration of this is seen in the fact that as late as Tuesday afternoon, 72 hours after the flood was in Pueblo, its crest had reached no farther than Syracuse, Kan., only twenty miles over the state line. In a broad river with slight downstream slope it is actually easier for the water to pile up and spill off sideways, and to back up behind the sluggish crest of the flood, than for it to flow away down the channel

(*Continued on page 500*)

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGE, M S A E

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

The Farm Market for Trucks

IF one is to know what the immediate possibilities are for the motor truck on the farm he must know what farmers all over the country think about farm trucks. The opinions of four thousand eight hundred and ninety eight farmers scattered all over the United States are now available. This information was collected by the truck-tire department of a prominent Akron tire concern, and we are able to pass it on to our readers through the courtesy of B M Pettit, who compiled the figures

Seventeen per cent of the four thousand eight hundred and ninety-eight farmers answering Mr. Pettit's questions *use trucks on their farms, the other* eighty-three per cent use horses Of the farmers not using trucks, forty-four per cent have considered buying them. To quote from the report

"We want to be conservative in the interpretation of these figures, so, in order to be ultra-safe let's assume that this investigation represents not the attitude of the total number of 6,700,000 farmers in this country but rather the attitude of the upper third or about two million farmers When we say forty-four per cent of the farmers have considered buying trucks, that automatically builds up in our mind possible sales within a reasonable time to forty four per cent of two million, practically eight hundred thousand farmers

"It is worth while to notice that the reply is fairly uniform from all farmers in the terms of the acreages which they cultivate We find that thirty nine per cent of those replying from farms of one hundred acres or less are considering buying trucks, forty per cent of those from farms of one hundred and one to one hundred and sixty acres, forty-six per cent from farms of one hundred sixty-one to two hundred and forty; and fifty-two per cent from farms over two hundred and forty acres We also notice the same general interest in the truck in the dairying as in the fruit belt, and in the grain field as in the livestock field In other words, neither

(*Continued on page 500*)

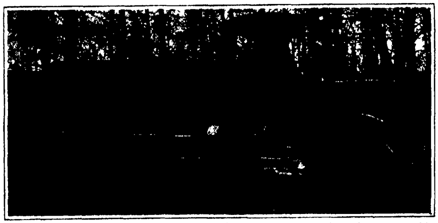
How the Long Island truck farmer hauls produce to the New York market in a rapid and economical manner in large trucks

Labor-Saving Truck Bodies

THE ingenuity of the modern transportation engineer is constantly taxed to devise new means of utilizing the motor truck advantageously, in cutting down the cost of transporting various materials. Most motor trucks of any pretentions now have a power take-off device fitted to the transmission so that the engine power can be used for performing other work besides propelling the truck The brick-carrying body illustrated is a good example of a special mechanism designed for carrying on a definite duty more economically than the conventional truck construction would permit As will be seen from the cut showing the body in the load dumping position it is composed of a box like steel carrying member attached to two tubular supports one on each side of the chassis, as shown Cables run over pul-

(*Continued on page 500*)

Brick-carrying body in dumping position



A 2½-ton truck equipped with log-carrying apparatus which makes it possible for one man to load and unload logs

***Left:* Short turning radius of an industrial truck-tractor demonstrated in aisle of machine shop. *Right:* Industrial truck-tractor with dumping body used in construction work, receiving a charge of concrete from mixer**

The Industrial Truck-Tractor

MENTION has previously been made of a special form of small motor truck propelled by a gasoline engine and intended for industrial use Its ease of control and compactness are well shown in accompanying photograph, showing it at work in the plant of an automobile manufacturer The truck tractor is flexible, has a short turning radius is built so low to the ground and is so powerful that it can be used for many purposes such as carrying a full ton load of shavings from the lathe, foundry sand red hot forgings or castings, finished or unfinished parts from one machine to another or between plants It will operate on rough roads as well as on factory floors It will plow through snow or mud through foundry sand or run on oil sodden floors Its ability to operate 24 hours a day without being laid up for recharging gives a positive advantage over electric trucks and its economical operation, coupled with the lack of breakage makes this machine an exceptionally efficient and satisfactory one for many commercial purposes Having nine and one-half inches of ground clearance and an abundance of power it can be run on rough ground, foundry floors, factory yards and bad roads Its range of speed, one-half mile to 15 miles per hour permits it to run slowly through congested places and around sharp corners, deliver its load exactly in the place desired without danger to machinery or employees, and to run at high speed through open places and in the traffic of roads and city streets

One of the machines was recently driven from Buchanan, Michigan, to Chicago, Illinois This machine was stopped at several of the large industrial plants on the way and most interesting demonstrations were held It covered a distance of 143 miles in one day and arrived in Chicago in excellent condition, ready to begin regular routing work in one of the well-known institutions

The fact that this machine is built entirely of metal and that its center of gravity is very low, makes it a most satisfactory one for foundry and forge shop use Extreme changes in temperature do not affect its operation Hot casting and forgings can be carried from one section of the plant to the other—quickly and without damage to the machine It can also be used to advantage in contracting and building operations as another photograph shows

Recently Patented Inventions

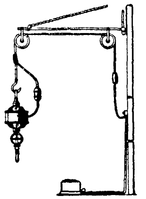
Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Pertaining to Aeronautics

RADIO AERIAL TORPEDO.—G. J. DYE, Dothan, Ala. This invention relates to apparatus designed especially for offensive operations in warfare. It has particular reference to an aerial device or machine adapted to be directed through the air to any desired elevation or distance, carrying a charge of high explosive and driven by its own power, while the direction of movement thereof is controlled by wireless apparatus from the sending station which may be either stationary or located on any suitable moving carrier, such as a battleship or aircraft.

Electrical Devices

PORTABLE MOTOR.—J. A. ANDERSON, 310½ Chickasha Ave., Chickasha, Okla. The invention relates to portable motors such as are used in connection with dental engines, portable fans and the like, and particularly to a suspension bracket whereby a motor can be suspended from any suitable support to actuate devices of various characters. The motor is relatively small to permit of its free movement from place to place.



SHOWING A STANDARD FORM OF DENTAL ENGINE BRACKET AND MOTOR

Of General Interest

DUSTPAN.—I. M. FREEMAN, address B. G. Patterson, 1111 W. 15th St., Oklahoma City, Okla. The object of this invention is to provide a pan, made from a single sheet of metal, cut to shape and bent to form an integral structure, and having a detachable handle pivoted thereto and a detachable rest for engagement by the foot to hold the pan in place. The pans are so shaped that they may be nested for shipment or storage in order to economize room.

CUE TIP HOLDER.—H. J. GRENIER, c/o Mrs. Jacobs, 40 Grassmere Ave., Fairfield, Conn. More particularly the invention relates to the construction of cue and tip, and means for removably securing the tip to the cue, an object being to provide a device which permits of the tip being removed and replaced as desired, the operation being extremely simple, and the construction strong and durable in use.

FIREARM.—W. E. ROSEBUSH, c/o Inland Empire Paper Co., Millwood, Wash. The invention relates to recoil operated breech loading hand firearms. The object is to provide means in automatic hand firearms of the concealed hammer type whereby the hammer can be securely locked when in cocked position and the sear rendered inoperative relative to the trigger. Another object is to visually indicate whether the hammer is in fired position and not in cocked position.

HEEL FASTENER.—L. CYRE, 49 Malden Lane, New York, N. Y. The object of this invention is to provide a heel fastener arranged to permit the manufacturer or repairer to quickly and securely fasten a heel on footwear or to conveniently remove a defective heel and replace it by another. The device is simple and durable in construction and inexpensive to manufacture.

Hardware and Tools

STOVE LID.—W. SCHARFHAUSEN, 321 Rear 1st Ave., Salt Lake City, Utah. This invention has for its object to provide a lid of the character specified wherein means is provided in connection with the lid for supplying steam to the fire box above the burning fuel, in quantities such as to insure conservative and efficient combustion of the fuel.

GRAPPLER.—J. C. GINTER, Box 1737, Breckenridge, Texas. The invention relates to a grapple for regaining tools which may be submerged. The principal aim is to provide a grapple having a tool receiving socket provided with means for gripping the tool and also with means for directing the tool into the socket. The device is reliable, efficient and cheap to manufacture.

Heating and Lighting

DRYING KILN.—S. E. CORNISH, 2636 Etna St., Berkeley, Cal. An object of the invention is to provide a drying kiln having means for moving material longitudinally therein and means for compelling a continuous circulation of air from the dry end of the kiln to the charging end of the kiln and in such movement compel the air to pass crosswise or transversely through the kiln any desired number of times.

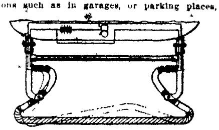
Machines and Mechanical Devices

BINDING MACHINE.—A. E. CRANSTON, 639 Peyton Bldg., Spokane, Wash. The invention relates to bundling machines for securing the parts comprised in a box or barrel into bundles. It is a purpose to provide a binding machine which is semi-automatic for use in small factories where it is not desired to incur the expense of installing a wholly automatic machine, or for use in larger factories where it can be employed as an auxiliary.

SHEET FEEDING.—C. WINKLER, Berne, Switzerland. This invention relates to a device for lifting separate sheets of paper from a pile by means of suction and blowing nozzles. When a sheet has been raised by the suction nozzles, the connection of the nozzles with the air pressure is cut off, and nozzles of a horizontally extended section begin to blow air under the sheet, so that this sheet is completely separated from the pile.

Pertaining to Vehicles

OBSTRUCTION ALARM.—M. ROSENBERG, 1228 Pacific St., Brooklyn, N. Y. This invention relates to safety attachments for automobiles or other vehicles. Among the objects is to provide means whereby when the vehicle is being maneuvered in close or crowded positions such as in garages, or parking places, the driver is enabled to devote practically all his attention to the controlling devices of the machine and hence is relieved to a large extent from attending to the conditions located especially at the rear of the vehicle.



A PLAN VIEW INDICATING AN ALARM CIRCUIT

Designs

DESIGN FOR A DISH OR SIMILAR RECEPTACLE.—F. PFEIFFER, SR., 1542 Gates Ave., Brooklyn, N. Y.

DESIGN FOR A BUTTON.—J. FOX, 49 W. 24th St., New York, N. Y.

DESIGN FOR A RING.—M. ROSSBIN, 17 W. 45th St., New York, N. Y.

DESIGN FOR A SIGN.—F. W. WILSON, 49 Maurice Ave., Elmhurst, L. I., N. Y.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical or scientific knowledge required therefor.

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What Is the Trouble with the Railroads?

(Continued from page 484)

volume of traffic, the fact that there is not a large volume to move, the next logical step is to ascertain why freight is nonexistent. To take up in detail the manifold reasons for the absence of traffic would be entirely beyond the scope of the present inquiry. But there is one alleged reason which it is pertinent to examine; and that is the assertion, heard with increasing frequency, that the Nation's business is stagnating because freight rates are prohibitive. Like many other delusions, this can be dispelled by a brief investigation.

In the first place freight rates are not high, absolutely or relatively, by any standard of measurement. The average revenue per ton mile is actually less now than it was before the Interstate Commerce Commission was established. In 1887, the year the Interstate Commerce Commission was organized, when the purchasing power of the dollar was much higher than it is now, the average revenue per ton mile for all the railroads was 1.6 cents. There was a steady decline until 1916 when the average receipts for hauling one ton of freight one mile was 7.7 mills. That is to say in order to earn money enough to buy a 2-cent postage stamp the railroads had to haul an average ton of freight a trifle more than two and a half miles. American freight rates were much lower than in any other country in the world.

From 1916 freight rates gradually increased until January, 1921, when the average was 1.21 cents per ton per mile.

Relatively to the price of other commodities railroad freight rates lagged consistently behind and are still bringing up the rear. Taking both freight rates and the index number of wholesale prices as computed by the Bureau of Statistics of the Department of Labor in 1913 as 100, it will be found that rates did not increase but actually decreased to 99 in 1916, returning to 100 in 1917. In 1918 rates increased to 118 but by that time the index number of wholesale prices had soared to 196. The wholesale price index number attained its maximum at 243 in 1920 while freight rates lagged 97 points behind at 146. Up to January, 1921, the swift decline in the wholesale index number and a moderate increase, followed by a decline in freight rates have brought the two within 11 points of parity, the index number of wholesale prices being 177, freight rates 166. In other words, freight rates are still lower than other commodities, comparatively speaking, just as they always have been.

Perhaps this point can be made more impressive by a few specific examples. The reason most commonly alleged for the present extravagant retail prices of fresh fruits and vegetables is the increased freight rates which, of course, must be paid by the consumer, so the examples may well be based on these most familiar products.

On April 16, 1921, the average price paid producers for Texas cabbage was $7 a ton. Freight charges to Chicago, including icing, for cabbage must be shipped in refrigerator cars, and the Federal tax on freight revenues amounted to $26.30 a ton. Total to farmer and railroad $33.30 a ton, or 1.67 cents a pound. On the same date cabbage retailed in Chicago at 7 cents a pound or $140 a ton, which was $106.70 a ton more than farmer and railroad combined received. Spinach on the same date yielded the grower $5 a ton; freight to Chicago was $30.36, total, $35.36. On the same date spinach retailed in Chicago at 15 cents a pound, or $300 a ton, or $264.44 more than both producer and railroad received. On the same date onions were $42 a ton in Texas; freight to Chicago was $29.64. Onions then retailed at 10 cents a pound in Chicago, or $128.36 a ton more than producer and railroad received.

So vociferous were complaints that high freight rates were interfering with the movement of fruits and vegetables from Florida to Eastern markets that Chairman Clark of the Interstate Commerce Commission investigated the matter. He found that shipments of these commodities from Florida from November 1, 1919, to March 1, 1920, were 26,886 carloads; for the corresponding period of 1920-1921 they were 28,420, an increase of 1,534 carloads. On this showing it would appear that the present freight rates can hardly be blamed for the unsatisfactory condition of the railroads.

In opening the inquiry by the Senate Committee on Interstate Commerce, May 10, Chairman Cummins read into the record statistics showing that while operating revenues have very greatly increased since 1918 expenses have increased still more with the result that net operating income for all the railroads for the year ending March 1, 1921, was only $2,578,922 as compared with $787,610,435 in 1918. As spokesman for the railroads, Julius Kruttschnitt, Chairman of the Southern Pacific, explained the practical wiping out of net revenues by saying that increased labor charges since 1916 aggregated $2,225,000,000, and that expenses over which the railroads had no control, because of prices fixed by the government or by general market conditions covered 97.5 cents of every dollar of operating expenses in 1920.

Meanwhile the mileage of railroads abandoned in 1920 exceeded the mileage built for the fourth consecutive year. From 1917 to 1920, both inclusive, 4,082 miles of railroad have been abandoned and only 2,700 miles have been built, so that there is an actual decrease of 1,332 miles of railroad in the four years. Only 1,998 locomotives were ordered in 1920 as compared with the high record of 6,265 in 1905 and an average of 2,060 for the five years from 1915 to 1919, inclusive. Only 84,207 freight cars were ordered in 1920 as compared with the high mark of 341,315 in 1905, and an average of 101,776 for the five years from 1915 to 1919. In other words, the task of providing an increase in transportation facilities adequate to insure the healthy economic growth of the Nation is not being performed.

From this it would appear that something very serious, indeed, is the matter with the railroads.

The Storm King Road

(Continued from page 485)

change, especially in details. One of the variations was the elimination of a bridge having a span of 200 feet. Another was the substitution of a cut for a tunnel. The cut was an expensive one and also difficult. It was feared, however, that the dip of the strata might result in precipitating the roof and wall into the tunnel excavation, since the rock is rather treacherous at this point. These are a couple of variations and rank among the larger ones. Sometimes it was found advisable to shift the location a bit to right or left. It is very probable that it has been wise to permit minor variations. The plans were executed without adequate information as to details, and presumably they had to be so executed.

The road is, for a considerable part, at a level varying from 250 to 400 feet above the river. This level is very precipitous, especially round the front of Storm King. The double track of the West Shore Railway lies at the foot of the mountain and close to the river. Of course, the railway had to be protected. Detached masses of rock and boulders were lying around everywhere. Some of these masses were of considerable size, overall dimensions running up to 10 x 15 x 25 feet. The boulders weighed up to 25 tons each. These had to be disposed of in some way. They were drilled and blasted into smaller since. This work had to be done with great care, particularly the blasting. Too much explosive, and the track below might be put temporarily out of commission by the fall of loose rock; too little explosive, and the boulder or big rock would not split. There was, in fact, excellent opportunity for the display of skill and judgment. Often the fragments were carefully lifted and then placed where their position guaranteed safety below. Effort was made to start with a narrow ledge, and to blast the cliff from this. The fragments would be kept on the ledge until they could safely be removed or else put into retaining walls or the like. A big wooden barrier was constructed at one point for the protection of the rail way track. It was located at one side of the track and its duty was to prevent falling rocks from bounding from their points of impact on to the railway. It was built not unlike a fence, and was made some 20 feet high and 140 feet long. Vertical posts were located at intervals of 4 feet and to these were spiked 2-inch planking. Braces, etc., were put in place to make all secure. And, nevertheless, some of the rocks broke through. Not far from this same location a blast was set off at a level about 300 feet above the track. A big fragment, weighing some 600 pounds, was hurled 1,200 feet horizontally out from the mountain side and struck fair and square on top of a telegraph pole.

The retaining walls are sometimes small and insignificant, and sometimes they are from 20 to 50 feet high Necessarily they had to stand upon solid footings It was sometimes necessary to go down to levels 10 or 20 feet below the surface in order to locate the footing properly.

When the Storm King Road is finished it will surely rank among the most notable in the world. The difficulty of construction and the wonderful beauty and picturesqueness of the view combine to make the new highway a remarkable addition to the valley of the Hudson, already famed in the annals of the New World.

Controlling the Lower Mississippi

(Continued from page 485)

to the extent of $773,618,600 in value was imported and exported during the eleven months ending May 31, 1920; and New Orleans takes her place as second port in America

Levees are built 10, 13 or 16 feet high On the river side the slope is one in three; on the land side it varies from one in four to one in ten The width of the crown averages from 8 to 10 feet, sometimes much wider, as for instance, at Canal Street, New Orleans, at a drop of from 5 to 8 feet on the land side, there is built a banquette or berme which varies from 20 to 40 feet, according to the height of the levee. In Louisiana about 65 per cent of the levees are built with the aid of power driven machinery; about 30 per cent by scrapers drawn by mules; about 5 per cent by men with wheelbarrows. The cost of work performed by machinery is 21½ cents per cubic yard; by mules with scrapers, 46 cents; and by men with barrows, 81 05 cents. Allowance made for settling or shrinkage of levee is 25 per cent of net fill, for work done by machinery; 15 per cent for scraper work; and 20 per cent for wagon work. The Levee Districts, the State Board of Louisiana and the United States Government have built about 18 miles of new levees in Louisiana during the past two years. Together with enlargement of levees, the work done covers about 10,500,000 cubic yards at cost of about $2,250,000. But the progress has not been so rapid as desired, because of scarcity and cost of labor and materials brought about by the Great War.

Much encouragement toward local activity has been given by the passage by Congress in 1917 of the Flood Control Act. This act, in general terms, "comprehends the extension, improvement and mainte-

NEW BOOKS, ETC.

The Airplane By Frederick Bedell, Ph.D New York. D. Van Nostrand Company, 1920. 8vo; 257 pp., illustrated.

Part of the material of this volume is a revision of the author's well known "Airplane Characteristics" and "The Propeller" As a whole, the re-written text and the seven new chapters constitute a practical handbook for flyer, designer, and general reader His students, many of them returned service men, have given of the fruits of their experience, and valuable suggestions by the manufacturers of aircraft are embodied in the volume

Secrets of Earth and Sea. By Sir Ray Lankester, K.C B, F R S New York: The Macmillan Company, 1920 8vo, 248 pp., illustrated

What is the oldest picture in the world? It is etched on a deer's antler, and is much better than most of the "new art" Sir Ray shows us this, and at the same time takes a fling at *Kipling's ethnology He tells us of* the origin of the swastika, of ancient monsters, of Vesuvius, of animalcules, and of many other curious things, and all in that "easy chair" manner of his which has endeared him to so many avid readers He can find the marrow in dry bones and serve it up as a tidbit, and from extinct monsters he provides an intellectual repast.

Powdered Coal as a Fuel By C F. Herington, M E New York D. Van Nostrand Company, 1920 8vo.; 338 pp, 124 illustrations

In the industrial world more and more consideration is being accorded to the claims of this form of fuel municipal lighting and power plants are using it after close investigation and experiment This second edition of a treatise by an author in intimate touch with actual accomplishment incorporates his more recent studies of what he calls a "really marvelous fuel," cites the wide uses to which it may be put, and compares erection and operation costs with those of plants utilizing other fuels These tabulations indicate a great economy and efficiency in favor of pulverized coal

The Day of the Crescent By G E Hubbard London, Cambridge University Press, 1920 New York: The Macmillan Co 8vo, 213 pp, 16 plates.

These glimpses of Old Turkey when her empire was swollen with pride, satisfy our longing for the exotic and picturesque and at the same time cast new light upon the history and character of a warlike people Old forgotten travel books have been resurrected and diligently searched for true atmosphere From the barbaric Tartar to the Grand Turke himself, a multitude of actors play their parts in the fascinating setting and ancient woodcuts are reproduced to bring the scenes vividly before the eyes

Cinema Craftsmanship A Book for Photoplaywrights By Francis Taylor Patterson New York Harcourt, Brace and Howe 8vo, 277 pp

The author, instructor of photoplay composition in Columbia University, gives the writer of scenarios a glimpse of the whole art and science of production, tells him how to shape his scenario, and leads him through the mechanical processes from manuscript to finished picture The book includes a complete photoplay exactly as written, and appeals not only to the writer, but also to the general reader who is sufficiently interested in moving pictures to wish to understand the steps in their progress from brain to screen

Historical Fiction Chronologically and Historically Related By James R. Kaye, Ph D Chicago Snowdon Publishing Co, 1920 8vo; 748 pp., fully indexed

We have waited a long time for this book, which fits historical fiction into history and keeps the gears in mesh one with the other We have very often wished to read books of historical fiction but have been deterred by lack of knowledge of the period and whether the characterisation would be "true to history." Of course there are some authors that always ring clear as a bell, like Charlotte M. Yonge, Georg Ebers, Ernst Eckstein or Charles Kingsley. Others we hardly hear of now, as Grace Aguilar, Mansoni, Harriet Martineau, Jane Porter and others To assemble such a galaxy of writers and novels as Dr. Kaye has done is a monumental task which has been performed with extraordinary judgment We are used to "Standard Opera Plots," "Songs Every Child Should Know," and so on, and now we have a thoroughly sound book with which all cultivated people should be familiar. A careful index satisfies the most critical demands. Look up Jane Porter for example. We find under "The Scottish Chiefs" that she was born at Durham in 1776, that she knew Sir Walter Scott, and that she inspired him to write "Waverley" We find that "The Scottish Chiefs" contains historical inaccuracies. Thus forewarned we get a succinct account of the book and its plot "Thaddeus of Warsaw," Miss Porter's other book, is similarly treated This is one of hundreds of examples Every private as well as public library should have this book on its shelves

The Thermionic Vacuum Tube and Its Applications By H J Van der Bijl, M A, Ph D New York McGraw Hill Book Company, 1920 8vo, 391 pp, illustrated

The passage of electrons through high vacua, as exhibited in thermionic tubes, discloses numerous functions that are rapidly being utilized in engineering fields and have already given rise to a large volume of literature describing the application of thermionics to practical problems This new work develops the principles of operation and coördinates the phenomena encountered The exposition is sufficiently elementary to take its place in the college laboratory, first acquainting the student with the properties and behavior of electrons, then leading up by easy stages to the more significant applications of the device

Aircraft and Automobile Materials of Construction Vol I, Ferrous Materials By Arthur W Judge New York: Isaac Pitman and Sons, 1920 8vo; 739 pp, 275 illustrations, 200 tables

Manufacturers designers and students may turn to this work with confidence, it contains the gist of many specialized books supplemented by modern data and by information from the records of societies The volume concerns itself with the composition, strength, properties and treatment of metals, the relationships between the critical and actual properties stresses and strains and test the machines and instruments used in testing are the subject of a separate section Tabular matter covers the properties of the carbon and alloy steels used industrially and furnaces and pyrometry are rather fully discussed from the works engineer's and constructor's viewpoints The usefulness of the exposition is of course not limited to aircraft and automobile manufacturers, but extends itself to all users of ferrous materials

London Days, a Book of Reminiscences By Arthur Warren Published by Little, Brown and Company Boston, 1920 285 pp, 12vo

The author is an American journalist of distinction, who for an extended period in the 80's and 90's was London correspondent for and later editor of the *Boston Herald* Mr Warren has a rare gift of pen portraiture and a keen analytical faculty and his London experience brought him into close touch with the leading men of that period To the scientific reader the most interesting chapter is the one devoted to Lord Kelvin Mr Warren gives us a picture of him 'He sat on the lower stair near the front door of his house making difficult calculations and strange diagrams in a little book bound in green morocco It would be five minutes before the carriage started, so out came the memorandum book which he always carried in his coat pocket, and he sat on the stair and worked ' He was seventy then, but his spirits were as young as those of the youngest of his students Says the author There was never such a man as he for asking questions . Whatever your profession, trade, interests in life, he would put questions that went to the roots of your matter ' Said he one day in a talk in his study "Patience, great patience is the need of this generation It asks results before it earns them"

Commercial Airships By H B Pratt, M I N A, Chief Engineer, Airship Department, Vickers, Ltd, with an introduction by Commander Sir A Travor Dawson, Bart, R N Published by Thomas Nelson and Sons, Ltd, London, Edinburgh, and New York 8vo, 285 pp

The author of this valuable work tells us that with the exception of purely historical works, there is a dearth of books in the English language dealing solely with airships, and that in view of this, he has included some chapters on airship design and construction in his book The work opens with a chapter on the evolution of the airship We learn that an Austrian, Schwartz, first attempted the construction of the rigid airship and built one of 130,000 cubic feet capacity with a framework of aluminum covered with aluminum sheeting which formed the gas container. It was the first ship to be fitted with a petrol motor one of twelve horsepower The first practicable airships were built by the engineer Juillot in conjunction with the Labaudy brothers The French were thus the pioneers Inspired by the work of Schwartz in '97, followed by that of the Labaudy brothers, Count Zeppelin developed and completed his first great ship Excellent chapters are those entitled "Commercial Possibilities," "The Airship as a Means of Transport and "Commercial Uses of the Airship" There is a chapter on possible transport routes and service, followed by one on proposed types of commercial airships Then follow a study of airship stations, airdromes, et cetera a chapter on the costs of maintenance, one on handling and navigating, and, finally, chapters on the structure, propulsion, interior arrangements, et cetera. A most valuable appendix is the log of the outward voyage of "R 34" the first airship to cross the Atlantic The book is very richly illustrated with half tones of the various types of ships, views of the interior and accommodations of *passenger ships, and some excellent construc*tional photographs It is also replete with charts, diagrams and line drawings, showing the main structural features of the completed ships

Europe, 1789-1920 By Edward Raymond Turner, Ph D Garden City, N Y: Doubleday Page and Company, 1920 8vo, 687 pp, 32 maps

The French revolution and the Great War are hail and farewell to a tremendous epoch—and epic—of European history, a spectacle the outward incidents of which have been recorded over and over, yet too often as isolated scenes, too rarely as prophetic promises and warnings Professor Turner has striven to see this epoch whole to follow the linked causes and effects and at the same time to stir the mind to further thought and interpretation The result is a gratifying measure of success, and a work that should be sought eagerly not only by colleges but also by the reading public It conveys an insight into the true significance of events, a sense as of climbing heights to see the panorama of the past outspread beneath our feet

The Pleasures of Collecting By Gardner Teall New York The Century Company 8vo, 328 pp, illustrated.

When you stumble upon an Old Curiosity Shop, do you feel an irresistible desire to peep in upon its 'world of yesterday"? Most people have something in them which responds to this call Mr Teall's shop is well stocked with American, European and Oriental antiques, and he conducts you from one object to another with such infectious enthusiasm, such sympathetic understanding, that a corner of the mantle of his authority falls upon the hearer's shoulders china and chintz and pewter, glass and Wedgwood and Sèvres, take on new meanings for him, both collector and general reader will retain the memory of a pleasurable and profitable hour

Modern Welding Methods By Victor W. Pagé, M S A E New York The *Norman W Henley Publishing* Company, 1920 8vo, 292 pp, illustrated

Those familiar with the comprehension and clarity this author brings to his instructional texts on the automobile and airplane will not need to be told that in this treatise on the art of joining metals we have a compilation of authoritative data and a manual of the best practice that is at once complete, up to date, and understandable to the mechanic and practical man Here are full descriptions of the oxy acetylene welding and cutting torch, the spot, butt and arc systems of electric welding and the Goldschmidt thermit process with helpful notes on forge welding brazing and soldering, and the heat treatment of steal Formulas and methods are plainly set down, and specially made engravings illuminate nearly every page of the text

Goin' Fishin'. By Dixie Carroll, Cincinnati Stewart and Kidd Company, 1920 8vo, 355 pp, illustrated

Like to go fishin with the editor of *The National Sportsman?* Then here is your chance As you tramp the outlands and whip the streams with him, he tells you weather and feed facts, talks of fresh water game fish, and explains the use of natural and artificial baits And he doesn't mind using the vernacular Yet his pungent conversation brings out the poetry of forest and stream and puts nature into your blood and many angling secrets into your brain "Where to Go-a Fishing" lists numerous good localities in Wisconsin, Minnesota, the north Pacific coast region, and Canada Major General Leonard Wood writes an introductory appreciation that strikes the keynote of the book.

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nance, under the coöperative support and activities of the United States, the States and the several Levee Districts of the States bordering on the Mississippi River, of the lines of public levees upon which the basins contiguous to the river, subject to overflow, are dependent for protection, and the promotion of such auxiliary works (bank protection, etc), as may be necessary to aid in the control of the river and to effect and maintain dependable navigation" The length of the river so to be treated is about 1,579 miles, extending from Rock Island, Ill., to the Head of the Passes at the mouth of the river in Louisiana, "presenting a field of activities more extensive and exhaustive than has at any time in the past ever been at all contemplated or thought possible"

Within the past year 10,000 cubic yards of levee have been placed at one wharf in New Orleans, another section of levee in the lower part of the city with an extent of 7,000 feet has been enlarged in such a manner that the crown has a width varying from 10 feet to as much as 45 feet The levees along the Navigation Canal, which is a new and great undertaking, connecting the waters of the Mississippi River and Lake Pontchartrain, will have a 10-foot crown, a canal slope of one in three, and a land slope of one in three and one in five

Facts About Concrete

(*Continued from page 486*)

other ingredient used for the batch

In confirmation of this, tests have developed that when 20 per cent more water is used than needful for maximum strength, the resulting strength of the concrete will be diminished substantially 30 per cent, while if a 30 per cent excess of water is employed the possible strength of the concrete will be cut down 50 per cent Apart from impairing the strength of the concrete and seriously affecting its capacity to resist wear or abrasive action, the surplus water virtually entails a waste of cement for excess water leads to the same reduction in strength that would follow if two or three pounds of cement were omitted Therefore for the sake of economy and the realization of the best results, only the smallest quantity of water should be used that will produce a workable mixture

In this connection, the Bureau of Standards has determined that much can be gained by seeing to it that dry rather than wet aggregates be utilized in preparing concrete (The term "aggregates" refers to sand, gravel, and broken stone—sand being called "fine" and the gravel and stone being spoken of as "coarse ") The Government experts state that wet aggregates, when these are proportioned by volume measure, as is so commonly the practice, require anywhere from one half to one bag more of cement per cubic yard of concrete than do dry aggregates Therefore, the wetness of the sand should be neutralized by increasing the quantity of that ingredient while reducing the amount of gravel accordingly—adding only the normal measure of cement Indeed, contrary to general belief, the U S Bureau of Standards has shown that with an "over sanded" mix and fewer pounds of cement per cubic yard, a concrete was obtained which, at the end of twenty-eight days, possessed a 26 per cent higher compressive strength than a batch composed of the customary amounts of cement, broken stone, and sand—the latter being wet in both cases

In the choice of the fine aggregate, preference should be given to smooth sands rather than to those commonly described as sharp because less water is needed to produce a workable mixture; and, again the coarser sand can be manipulated easier with a smaller measure of water than fine sand. But above everything, it is of the utmost importance that the sand be clean and free of humus or vegetable matter. These organic impurities are apt to affect seriously the ultimate strength of the concrete A simple test has been devised that makes it practicable to detect quickly the presence of these weakening factors, even though they may not be visible If sand, by weight, be vitiated by one-thousandth part of organic impurities, the strength of the concrete will be diminished nearly 25 per cent This is a warning to people given to using any likely looking sand that may be available.

And now we come to one of the paradoxes in this matter of producing a concrete that will prove strong and wear well in service. Today, concrete is extensively employed in the construction of floors, loading platforms, pavements, etc, calling for sturdiness and also a notable capacity to resist abrasion While it is desirable to use only enough water to produce a plastic mixture, nevertheless it is indispensable that there be sufficient water to bring about the proper hydration of the cement Otherwise, if the concrete dry out too rapidly and the curing conditions be not favorable the material will be deficient in strength It seems that the proper curing of concrete is second in importance to the control of the water content That is to say, the concrete must have as much water as possible during the time it is setting and hardening Therefore, in order to arrest premature drying, and to prolong evaporation for ten days or more, the concrete should be covered with damp sand or earth or protected by wet burlap Treatment of this description may make all of the difference between an ultimate compressive strength of 1,300 pounds per square inch and 4,850 pounds per square inch

Properly compounded concrete grows stronger with age, and a barrier of concrete 2 inches thick will show a water penetration of only half an inch after exposure for 24 hours to a hydrostatic pressure of 60 pounds, while limestone and sandstone of substantially the same thicknesses will reveal penetration through and through in the course of anywhere from 10 seconds to about 20 minutes The time given to the mixing of cement is vital to ultimate strength, and where this is done by machine the mixing should continue for at least a minute instead of for a maximum of 40 seconds, which is the general practice Finally, investigation has established that many coarse aggregates heretofore deemed unfit for working into concrete can be used without hesitation and with excellent results if they be added in approved proportions

Regardless of the amount of water employed in a batch care should be taken that the water is not extremely alkaline nor charged with organic matter Water may be used at temperatures ranging from the freezing to the boiling point, without producing any effect, but hot water is recommended in cold weather to make certain of ridding the aggregate of frost From what has been said it should be clear that the man of research has placed concreting upon an entirely new plane, and he has demonstrated that the combining materials impose conditions in their choice and handling in order to insure the most satisfactory results

If newly cast or laid concrete be kept warm and moist operations may be carried on during the cold months If the surfaces of reinforcing metal be clean and free of oxide the concrete will grip the steel and make an intimate bond And then, if the fresh concrete be mechanically tamped or subjected to pressure, thus compacting the mass and squeezing out water, the material will be the better and stronger for this treatment. Whatever may have been the opinion as to the value of concrete for the building of highways, the fact is established that from now on we must recognize its superior merit. The concrete road is low in upkeep, offers the same surface in hot or cold weather, and requires a good deal

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less tractive effort than any other type of prevailing roadbed.' Concrete structures will stand up under fire where stone buildings would be apt to succumb; and experiments have been made which reveal that gravel concrete columns can be rendered further immune to flame by coating them with plasters composed of gypsum, hydrated lime, and kieselguhr. And bitter experience has emphasized that the round concrete column is better able to endure intense heat or a blaze than one that is rectangular in section. In brief, a great deal has been learned latterly about concrete, and yet the investigator is busy seeking further enlightenment The quest for knowledge is for the purpose of widening the ways in which concrete can be used confidently—eliminating the while the hit-or-miss methods of the past

Making the Airplane Fireproof

(*Continued from page 487*)

vents the fire from entering the helmet. A small window of two thicknesses of 1/8-inch mica with 1/4-inch air space is provided. The suit proper is made of 1/4-inch sheet asbestos with a 3/8 inch inner lining of hair felt. Both shoes and gloves are made of the same material as the suit. The weight of the suit with the helmet is 15 pounds, but with a few refinements this could be brought down to about 10 pounds.

Because of the fireproof nature of an airplane treated by his process, Mr Bradley has gone a step further and equipped aircraft with fireworks and flares for exhibition purposes The wings, struts, turtle back, tail and other parts of a fireproofed plane are covered with fireworks, and under the fuselage a dozen huge flares are mounted, all being wired for battery ignition, so that the pressing of a button by the pilot sets off all the fireworks and flares at one time The effect at night is, obviously, most spectacular—and absolutely safe, according to the inventor

The Craters of the Moon

(*Continued from page 491*)

be a good deal of fractured and crumbled material in the ridges and peaks?

The bombs dropped on Langley Field were all of them moving at a much less speed than a representative meteoric body Meteors are understood to enter the earth's atmosphere at velocities ranging, generally, between 10 and 40 miles per second. Such a body striking the moon's surface with its velocity unimpaired because of the absence of a substantial atmosphere would, Maj Ives calculates, if all the heat generated be retained in the meteor, produce a temperature of 270,000° F This temperature would gasify all known materials, even if nine-tenths of it were dissipated into the materials surrounding the meteor; so that finally we should have an explosion A military bomb will, accordingly, be a better experimental substitute for a meteor than non-explosive objects. In common with the objects used in early experiments, the bomb generates but little heat in the surroundings at the moment of impact; but, in contrast to them, it does imitate the explosive effects. The calculation of the temperature produced was based upon the minimum speed of 10 miles per second. The higher velocities would naturally produce still more excessive temperatures. One reaches the conclusion, then, that meteors behave upon impact much as do military bombs—that is, they give rise to an explosion.

The ability of a bomb to produce the central peak in a depression is shown very markedly in our third photograph. This is perhaps a more pronounced case than any on the moon itself. But the holes made on Langley Field are of all descriptions. Thus we have the extreme case of a crater floor free of projections, except perhaps close up at the foot of the circular cliff.

In our final picture we have the lunar craters Theophilus and Cyrillus, the one overlapping the other A similar instance on Langley Field is shown in the second view of page 490

In conclusion, one may say that the new evidence tends to rehabilitate the impact hypothesis; and that we still have a formidable alternative to the volcanic idea, notwithstanding Professor Pickering's vigorous handling of the subject in favor of the latter, in his work on *The Moon*, published before this evidence from Langley Field was in existence

Cacti and Their Uses

(*Continued from page 492*)

pads, or joints, may be cut into strips and cooked like string beans, or boiled as greens, or stewed like okra, or fried like eggplant, or pickled, or made into sweetmeats like citron "Tuna cheese" is made from the fruits of certain cacti, while the juice of red fruits is often used in coloring ices, jellies, and candies, and even in water-color painting

The traveler who "knows how" need never lack for water where there are cacti. He may cut off the top of a barrel-cactus, pound up the pulp and squeeze the water from it into his drinking cup He will find it slightly salty and bitter, but clear and rather palatable Or he may support a cactus trunk on stones, build a fire under each end, and make a hole in the middle, from which the water will gradually trickle

The Indian traveler also uses the milky juice of Mamillaria for healing cracks in his feet or for internal complaints when on long journeys One of the most curious and interesting of the cacti is the "mescal button," or "peyote," which is a strong stimulant and allays all hunger and thirst and fatigue for the time being The Tarahumare Indians and Huicholes of Mexico make a cult of the "peyote," going on long pilgrimages in search of it and employing it both medicinally and religiously as a cure for all bodily ills and a powerful aid to abstinence

In certain parts of Mexico, Sicily and elsewhere, the natives live almost entirely on fresh cactus fruits when they are in season They grow them in gardens and orchards and often gather them at dawn when they are coolest, although their temperature is always below that of the surrounding air They are also used in salads, preserves, pickled with lemons, dried, fermented as a beverage, made into a syrup called "tuna honey," a thin paste called "melcocha," or a thick paste similar to guava jelly. Even the seeds are sometimes dried and saved to use when the fruits are gone

The Barbados gooseberry, used for tarts and sauces in the West Indies, is apple-shaped and decorated with small leaves or bracts The plant, *Pereskia aculeata*, is a straggling shrub with slender branches, recurved prickles glossy-green leaves, and clusters of pale yellow bowers.

The prickly pears, or tunas, are abundant and much used They are pear-shaped or globular, weighing from an ounce to a pound, red, yellow, or purple in color, and usually sweet, though sometimes acid in flavor The skin contains clusters of tiny spicules, or glochidia, which are very irritating if taken into the mouth, so that care is required in peeling them They are sometimes called Indian figs or Barbary figs because of the numerous small seeds which they contain. Several species of Opuntia are cultivated for their fruits as well as for their edible joints The flowers are large, usually yellow or orange, rarely rose or red.

Delicious fruits are those of *Cereus pitahaya* and its relatives This species grows to the height of sixty feet and its trunk reaches two and a half feet in diameter The fruit is gathered at dawn with long reed sticks armed with several prongs.

The fruits of *Cereus giganteus*, a handsome cactus of the Southwest, are also much esteemed either in the fresh state or preserved. They are egg-shaped, two or three inches long, green on the outside and

". . . places far apart are brought together, to the present convenience and advantage of the Public and to the certain destruction, in time, of a host of petty jealousies, blindnesses and prejudices, by which the Public alone have always been the sufferers."
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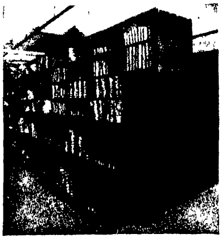

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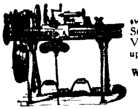

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crimson within The strawberry pear, obtained from *Cereus triangularis*, is pear-shaped, bright red, with slightly acid pulp, making it desirable in the fresh condition or as an ingredient of the "pepper pot" of the West Indies. Excellent fruits are also produced by *Lemaireocereus thurberi* and certain other large tree-cacti, and these "pitahayas" do not have the annoying prickles found in the fruits of Opuntia

"Garambullas" are the small currant like fruits of Myrtillocactus. They are eaten fresh or dried like raisins The melon cacti produce a number of small edible fruits resembling tiny scarlet radishes or red peppers. The Mexican strawberry, found on a species of hedgehog cactus, is salmon-colored, two inches in length, and very sweet in flavor. It gets its name from its numerous minute seeds Tetezo figs, so important to the natives of southern Puebla, are the fruits of a species of Pachycereus.

Although may of the wild cacti furnish valuable food for man and beast, it must be admitted that there is room for improvement both in the quantity and the quality of this food I have visited Mr Burbank's experimental grounds in California and fully realize the difficulty of his task in dealing with the cacti and the importance of his results His problem was to take a vagrant, forbidding plant, and divest it of its thorns and prickles, breed out its indigestible woody skeleton and improve *the size and flavor of its* fruits

Of the twenty or more genera in the cacti he selected opuntia because it was widely distributed, readily adaptable to soil and climate, hardy, thrifty, with edible pads and fruits, and already represented by *some* spineless varieties He secured 75 species and 600 varieties of this genus from all parts of the world and selected from them plants that appeared to possess the greatest number of good qualities Seeds from these plants were sown by the thousands and the new plants hybridized in order to break up their fixed habits Gradually a few plants were obtained by crossing and selection that were spineless After obtaining and fixing one good quality, he sought another and another, until, after ten years of very exacting labor, he gave to the world his "spineless cacti"

A number of these spineless forms, obtained from Mr Burbank may be seen growing in the conservatories of the New York Botanical Garden Some are especially suitable for feeding cattle, while others bear delicious fruits Before the cuttings will grow they must be wilted in the hot sun for a week or more, after which they are partly buried in soil or ashes When planted out in fields or orchards, they should be set three or four feet apart in rows eight or ten feet apart.

The fruits of these Burbank creations are over three inches long, usually yellow or red in color, and have flavors all their own, resembling those of peaches, melons, pineapples, etc The amount of sugar is large, being 12 to 16 per cent which gives the fruits their sweetness and much of their food value They may be sold for the price of oranges and it costs only half as much to grow them, while there need be no fear of a poor or failing crop The food value of the spineless pads for stock is about half that of alfalfa, and enormous crops can be grown without irrigation on arid or sterile land unsuited to other crops

Colorado's Cloud-Burst

(*Continued from page 494*)

Pueblo, situated at the confluence of the Fountain and the Arkansas Rivers, got the full benefit of the flood in both streams

The map on page 494 shows the part of the Arkansas drainage system in which the flood had its origin The contour lines are drawn for intervals of 250 feet They indicate the great difference in pitch between the Arkansas on the one hand and its tributaries on the other Without cluttering the map up with so many lines as to make it unintelligible we found it impossible to do more than suggest the facts that the banks of these creeks are likewise steeper than those of the main stream, and that the latter is really bordered, below Turkey Creek, by a very considerable alluvial plain little higher than the water We have been able to locate approximately one of the dams that broke, but the Geological Survey maps, the source for this as well as for practically all commercial maps of the United States or parts thereof, antedate the dams, so we are not able to show all of these

Floods are nothing new to this region. Heavy rainfalls are common in the mountains, and it is a frequent occurrence to find the Arkansas occupying more or less of the broad flat space between its *normal banks and the foothills at either side* The extreme severity of the present visitation is due to the fact that many days of unusual rainfall were followed by the cloud-burst and the going out of the dams The damage may be roughly divided under three heads Most of the loss of life was *in* the low *parts of* Pueblo, which were completely inundated, many houses being swept off their foundations by the unexpected rush of the water before their occupants could make a move toward safety Then the floor of the river valley, as it gradually widens from the mouth of the canyon to Pueblo and beyond, is occupied by farms, which have suffered a great deal of damage to their standing crops as well as to their buildings Finally, the railroads, building as they must along the line of the streams, have had much of their track swept away, while there has apparently been some loss of life from trains that were overtaken by the flood and swept from the tracks.

The floods at Denver and other points in the northern part of the state appear to be due entirely to the gradual rise of the streams under the influence of many days of rather steady, heavy rain We read of no cloudbursts in this section, and of no dams going out This is the reason why the floods here, while severe enough, have not approached those at Pueblo and other points in the Arkansas River drainage system But the Platte, which will eventually receive the flood waters from the northern part of Colorado, has even less of a real channel or valley where it passes through Nebraska than has the Arkansas through Kansas, so we may look for more serious secondary effects here than in the case of the Pueblo floods

The Farm Market for Trucks

(*Continued from page 495*)

the size of the farm nor the type of farming has any monopoly on the interest in trucks

"We believe we know fairly well why some farmers have bought trucks, but what about those who have not bought trucks? We want to know if this negative is a permanent one, if they are not buying trucks, is there any possibility of showing them the real economy of this kind of hauling? With this in mind, we find thirty three per cent of the farmers give as a reason for not buying trucks some reason that is classified as 'Financial' We find eleven per cent give bad roads and, incidentally, that is somewhat lower than we anticipated We find that of those who say that they do not have the cash or credit with which to buy motor power for transportation, sixty-two per cent own automobiles and eighteen per cent own tractors. In other words, they have actually paid out money for the purchase of motor power in some of its phases, but are not as yet sold on the fact that this is applicable to the transportation of their crops, though they recognize the value of the same kind of power for personal transportation or for use in plowing and harvesting the crops.

"Of the farmers using trucks, forty-two per cent are using tractors. Here we find that the truck and tractor are not competitors as the smaller farmer is a less extensive user of the tractor than the larger farmer, while the truck is equally applicable to all sizes of farms. The size of the truck best suited to farm use is a subject *of much discussion* among truck manufacturers and salesmen as well as farmers.

"Regardless of the size of the farm, there is relatively little interest in a truck of less than one ton. We find from the report a very marked interest by those who have not yet bought trucks, in the one-ton trucks, in the ton-and-a-half and two-ton trucks. If we take this by the size of the farm, for example, we find forty-one per cent of them with farms of one hundred acres and less are interested in the one-ton truck. Of those farming *over two hundred and forty acres, twenty*-two per cent of them are interested in the one-ton truck, while only one per cent are interested in a truck of less than one ton We find in the larger acreages thirty-nine per cent are interested in the two-ton truck, while twenty six per cent of the farmers farming less than one hundred acres are interested in a two-ton truck"

Labor-Saving Truck Bodies

(*Continued from page 495*)

leys at each end of the tubular support, these cables being operated by means of gearing from the power take-off of the transmission When the body is carrying a load of brick it rests in a horizontal position and the actuating member attached to the body frame is down at the lower end of the tubular support near the large sheave When it is desired to dump a load of brick the engine power is diverted to the cross-shaft carrying the two large pulleys over which the cable runs, and as these pulleys rotate the body-actuating carriers are moved out on the tubular supports and the body is shifted from the horizontal position it normally occupies *to the angular position* necessary to dump its load. The construction outlined makes it possible to clear the rear end of the chassis with the body and have it assume a nearly vertical position so that the bricks may be deposited on the ground in the same orderly way in which they were loaded into the truck body.

Another use of the power take-off is outlined in the photograph of the 2½-ton truck which is equipped with a special log loader which makes it possible for one man to load or unload large logs unaided, except for the engine power, that would *require a gang of men to handle* with the simple skid equipment ordinarily provided for lumbering operations The log-loading mechanism is very simple. It consists of a windlass roll carried at the side of the chassis by suitable bearings and extending from the cab to the rear end The log to be loaded is encircled by a chain, the end of which is attached to one of the hooks on the windlass When the engine power is diverted to the windlass-operating gear by the simple foot-pedal control, mounted on one of the steps, the chains roll up and drag the logs up the skidway and on to the truck frame.

Another simple device which saves considerable time is fitted to a truck of the Kansas City, Mo, Telephone Company This truck is equipped with a simple hoist or derrick for raising and setting telephone poles. Recently the truck and a gang of three men, one of whom was the truck driver, made a record of setting forty poles in one hour. The holes had been dug and the poles distributed before the feat was attempted. It is stated that, before this truck equipment was put into service it required six men to raise and set eight poles an hour. The truck is not only useful in general construction work, such as installing pole lines, but it is also valuable for drawing cables through conduits and for general emergency wagon work.

IN THIS ISSUE:

CANADA'S GREAT SHIP CANAL
TRICKS OF TRAFFIC CONTROL

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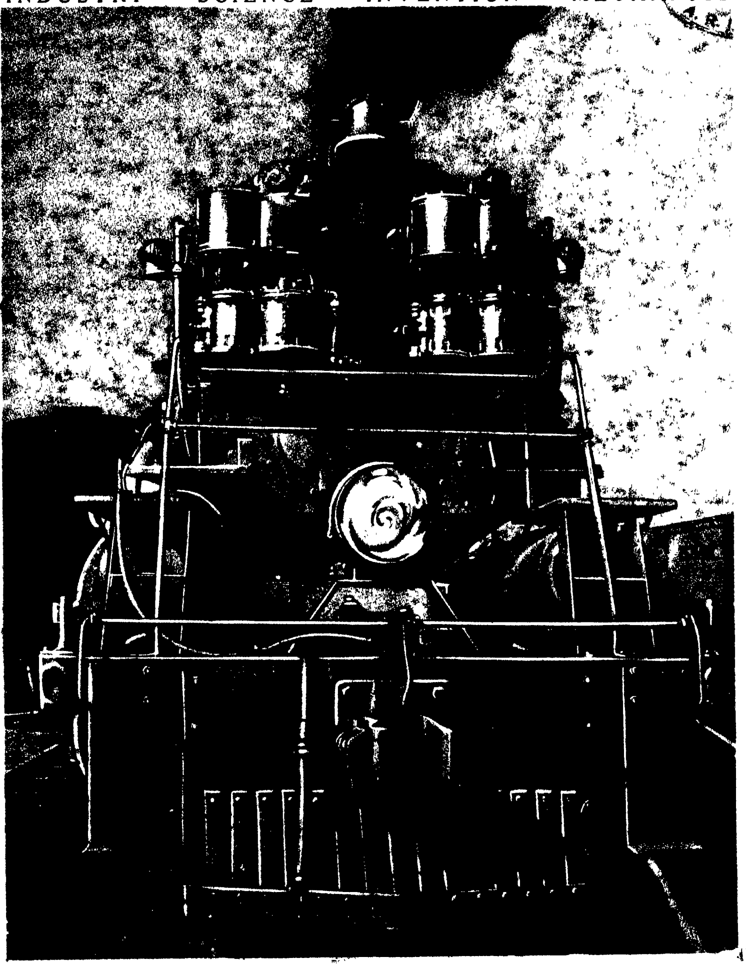

FRONT END OF 70-CAR, 9,000-TON COAL TRAIN, USED IN BRAKE TEST.– (See page 506)

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June 25, 1921

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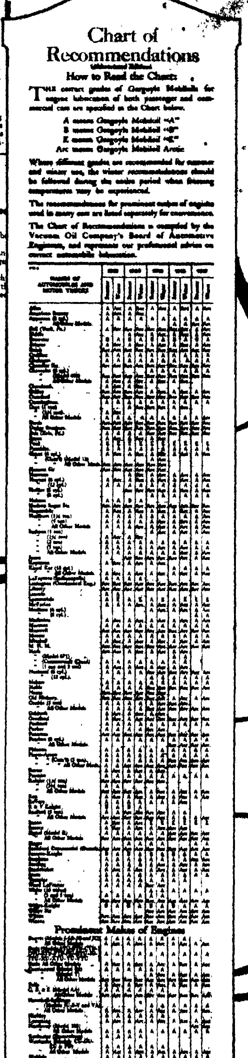

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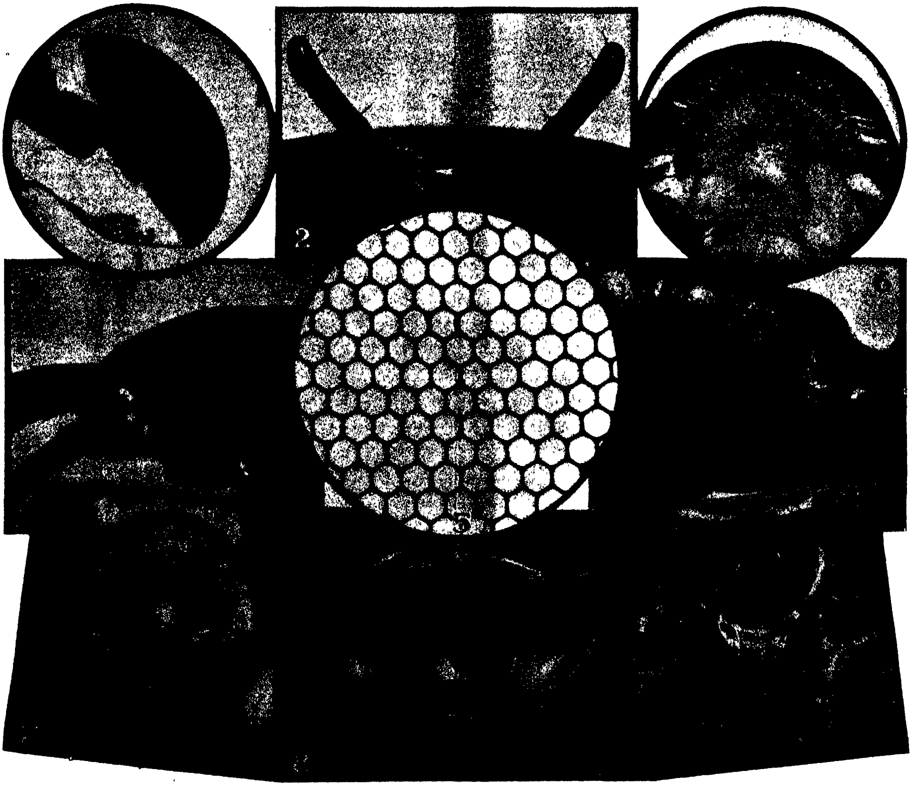

1. Eye of worker bee (15) thin section cut horizontally through the middle of the organ, showing the radial arrangement of the retinal cones 2 Eyes of the fiddler crab (5) these compound eyes on the ends of their movable stalks are capable of being pointed in all directions 3 Eye of crayfish (15) section prepared for the microscope, showing the cornea, which in this species is often moulted and replaced by a new one. 4. Head of gammarus, an amphipod crustacean (12) · the unstalked compound eye here assumes a primitive form, its fusion with the carapace being marked only by a slight bulge. 5 Cornea of a butterfly's eye (200) there are 17,000 of these facets in the compound eye of this insect each unit representing a complete eye in itself 6 Head of prionus, the wood-borer (8) : the great expansion of the eyes in this beetle is an adaptation to enable it the better to see its prey 7 Chauloides pectinicornis, a fierce huntress of the ponds (12) note the three simple eyes arranged in a triangle at the front of the head, between the two compound eyes. 8 The giant water-bug (12) these great compound eyes are for the purpose of seeing the prey through a reasonable distance of water This insect will attack a fair-sized frog 9 Small garden spider (12) this familiar species has eight simple ocelli which are supposed to function better in the dark than compound eyes, which the creature lacks entirely The figures in parentheses indicate magnification in diameters

Typical eyes of insects and crustaceans, showing simple and compound, stalked and unstalked forms—(See page 509)

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Compromise, with a Big Stick

THREE navies of commanding importance stand in a class by themselves—those of the United States, Great Britain and Japan Each of these nations considers a big navy essential for its welfare The first is a continent and entirely self-supporting —the other two are islands of limited area, and therefore are entirely dependent upon the keeping open of sea communications for their existence Particularly is this true of Great Britain, since the sea is not only the artery through which flow her supplies of food and raw materials, but it is the only link which binds together the many elements of an empire of some 400 million people It is for this reason that she has hitherto insisted on possessing a navy of sufficient strength to keep open the sea routes against any possible enemy or combination of enemies

We are more happily situated for so vast is the extent of our country, so varied and abundant are its resources, that even if a combination of enemies could blockade our coasts we could support ourselves indefinitely, and with our great manpower and unrivaled productive capacity, we could quickly crush any expeditionary force that might land on our shores The call for a big navy is based upon considerations of our extensive coast line which we must defend, upon the fact that we have the Philippines, Hawaii and Porto Rico to protect, and the further fact that the Navy now has under its care the second largest merchant fleet in the world

The British Admiralty, through its First Lord, recently announced that it had abandoned its policy of building a supreme navy, and for the future would be content with a navy equal to any other, that is to say, of the same strength as our own This momentous abandonment of a policy which has the sanction of centuries of British history behind it, was accompanied with the statement that Great Britain refused to regard the growing strength of the United States Navy as any menace to her own security. As proof of the good faith of this pronouncement, Great Britain has cut her naval strength down to the bone, and has scrapped a fleet which is comparable in effective strength to the unbalanced fleet which we possessed in 1914 She has not laid down a ship since the armistice, and has only now authorized four battleships as replacements for her earlier battleships which are within a year or two of the obsolescent stage

Japan has a program of new construction on hand The ships she is actually building represent only a fair proportional addition to her existing fleet She has also authorized an additional program for which no appropriations have been made, being stimulated to do this (so her statesmen have said) by the large program of new construction in the United States Work on the new Japanese program is being held up, pending the discussions on disarmament which are now under consideration, Great Britain recently voted a small sum to be expended this year in laying the keels of their proposed four ships

President Harding, with the concurrence of both Houses of Congress, purposes to call a conference in which the three nations can gather about the table and arrange for an understanding as to the future size of their respective navies, the amount of new construction to be undertaken and, probably, for a division of the work of keeping the seven seas open and safe for the traffic of the world

"Disarmament" is the generic term by which the object of the conference has been designated The term is misleading No advocate of the movement expects or wishes that it should lead to *absolute* disarmament. Mr. Harding will not call upon the navies concerned to sink their battleships, disband their crews, and dismantle their dockyards A navy is as essential to a nation as a police force to a city A better designation would be "regulated" or "non-competitive" armament. Should this be brought about, the mad race of one nation to outstrip another—a competition born of fear and lashed to white heat by national hatred—will end. Distrust will give place to discussion, rabid hate mongering to calm reason, and the strength of navies will be proportioned to the acknowledged responsibilities and proper commitments of the nations concerned

But we must not go into the conference room with a big stick in our hands Strange to say, there is danger of this, for you may meet both in the Navy Department and in the Senate men who will say "Let us complete or insist upon the completion of the whole 1916 program before we enter any conference That will put us in a strong position, and we can thus bring Japan and Great Britain to our terms" Could anything be more fatuous—or more naive As Senator Borah so aptly said "If we enter the conference with our navy shipbuilding going full blast, Japan will not listen to our words—she will be hearing the clatter of the riveting hammers outside the door"

There might be some economic loss if the three nations shut down absolutely for the few months during which the conference met but we have faith to believe that the loss would be made up a hundredfold in the cutting down of future naval budgets, and a thousandfold in the moral gain to the world at large

Shipping Troubles

WE have before us an analysis by the editor of the *Shipping World* of the discouraging conditions which existed in the British Merchant Marine in the spring of the present year It is the statement of one of the world's best authorities on shipping matters, and all that he says of conditions three months ago may be repeated with greater emphasis today One cannot read this material without being struck by the fact that like causes have produced like effects on our side of the Atlantic In commenting on the report of the Liverpool Shipping Association, attention is drawn to the fact that though the ship-carrying power now available in the world is sufficient to deal with a larger volume of overseas traffic than was handled in 1913, and the needs of Great Britain as a consumer are greater than ever before, yet in 1920 the overseas commerce of the United Kingdom was in weight 19 per cent below, and the exports 56 per cent below those dealt with in 1914 Today, of course, the situation is considerably worse than that in 1920, although the British tonnage available was at least equal to, and the foreign tonnage available was far in excess of, that afloat in 1913, there was used in the overseas trade of the United Kingdom in 1920 ship-carrying power only in the proportion of 80 against the 100 employed in 1913 Furthermore, although more ships were employed, under the present conditions it is taking five ships to do the work that was performed by four ships in 1914

Bearing in mind conditions in the deep sea trade in this country, there is something familiar in the British analysis of their own troubles. We are told that the advance in wages has raised the cost of production and transport, making it impossible for the British to sell their exports in foreign markets We are assured that, in the main, it is the advance in food prices which has brought about such an advance in wages Take note also of the fact that they have reached the maximum traffic which can be dealt with through the ports working under prevailing conditions, and unless those conditions can be altered, it will be possible to import only five-sixths of the overseas supplies of food obtained under pre war conditions Hence follow scarcity and high prices, continued demands for high wages to meet those prices, a cost of production which makes selling of manufactures and coal in foreign markets an impossibility, constant curtailment of production; a decrease in exports, and last, a further and inevitable reduction in imports Thus the whole thing runs in an endless circle, and it can truly be said that, with modifications due to local conditions, we are passing through a similar experience. The principal modification as between us and Great Britain is the question of exchange; but of our merchant marine, as of theirs, it is true that the greatly increased costs of operation constitute a severe handicap Indeed, in this respect we are in a more parlous state than they; this for the reason that our impossible navigation laws—the burden laid upon our shipping by the suicidal LaFollette Act—renders successful competition on a common rate basis out of the question.

Developing White Coal Resources of France

FRANCE proved herself heroic in the war, and she is showing herself to be not less so in the peace which has followed Of men she sacrificed nigh upon one and one-half million, and of her land, ever so dear to the heart of a Frenchman, she lost the fairest, and industrially the most productive section. Speaking of her peacetime effort, we use the term "heroic" advisedly; for the statistics which the Government has recently given out showing what has already been done in reconstruction of her devastated provinces, prove what a stupendous effort this sorely stricken people has made

The coal which Germany is now sending into France will partly fill the gap which was caused by the enemy destruction of the Lens coal fields, and the French Government is now planning to reinforce the steam-power output of the country by the development of the abundant waterpower which resides in the rivers of the country, and particularly in the River Rhone.

According to a statement by President Millerand, France is about to undertake the greatest series of engineering efforts ever attempted in that country, by its reconstruction of the canal from the Rhine to the Rhone, together with the execution of large hydro electric projects which form part of the scheme. The existing canal which, if we remember rightly, owed its construction to the genius of that great engineer-soldier, Napoleon I, is to be widened and deepened so as to permit the passage of shipping between the North Sea and the Mediterranean

The Rhone, in the upper part of its course, runs through gorges which lend themselves admirably to the construction of short but lofty dams, and for the present the French engineers are concentrating their attention on two such structures, each of them 200 feet in height One of these installations will yield 120,000 horsepower on a normal flow of the river, and a second dam will add another 300,000 horsepower After these two dams have been completed, other hydro-electric plants will be built in various gorges of the river which, upon their completion in future years, will place a total of one million horsepower at the disposal of the industries of the south of France In the construction of these large dams it is probable that American practise will be followed, and we understand that a commission of French engineers is making a study of the extensive works built by our own Government Reclamation Service for development of the arid lands of the western continent The material of construction will be concrete, and we understand that a facing of special brick will be laid upon the upstream face of the dams It is estimated that it will take about four years to complete the first part of this great project, and the indications are that the entire cost of the works will be repaid, at the present rates for electric power, within five years after the power stations commence operation.

Venus vs. Comet

NO more amusing incident of popular science misinformed has come to our attention than the one that kept all New York agog on the afternoon of June 18th This was a beautiful clear day, and Venus was an evening star, neither insufficiently arrived nor too far gone This of course meant that she was easily visible to the naked eye in broad daylight, if the eye could but be turned upon the exact spot By some merry accident, some unidentified person's uninformed eye was so turned, and the glad tidings spread through the city that the Pons-Winnecke comet, which had been much mentioned in the papers, was to be seen The serious business of the city was entirely given over in favor of star-gazing, and thousands of people saw the "comet," or pretended they did, until the early evening papers, having consulted us and other authorities, gave the thing away. The comet, of course, is quite beyond the power of the unaided eye

Electricity

Photographs Through Walls.—To prove the immense penetrating powers of X-rays, M Contremoulin, before the French Academy of Science, produced photographs of human bones which were taken across a courtyard 250 feet broad and through a thick brick wall This shows the necessity of proper protection when using powerful X-ray apparatus

Barranquilla Radio Station. — It is reported that the towers and buildings of the radio station at Barranquilla, property of the Marconi Wireless Telegraph Company, are now completed, and the arrival of the further equipment is all that is necessary to place the station in operating condition The site of the station is on the high ground about 2½ miles from the business section of Barranquilla

Port Burwell Radio.—The opening of the new radio telegraph station at Port Burwell, Ontario, is announced by the Canadian Department of Naval Service This station has been equipped with the most modern sending and receiving apparatus Three expert operators are in attendance and its range covers the entire expanse of Lake Erie, as well as linking up with the chain of radio telegraph stations now extending from Port Arthur to the sea, thence to Labrador and the outer reaches of Nova Scotia and Newfoundland

Finland's First Radio School has been in operation since the end of September, 1920, as the result of England's new law prohibiting all ships of more than 1,600 tons from remaining in English harbors without a radio apparatus Only those persons were admitted to the school who had served previously as military radio operators in Finland Eleven pupils completed the course in December and received their certificates The school is private and without Government support Up to the present time very few Finnish vessels have been equipped with radio, but it is expected that others will soon instal it

A High-Capacity Storage Battery. — A description of a very thin plate storage battery having about three times the exposed surface per pound of material compared with any other commercial battery was given in a recent paper read before the American Electrochemical Society The electrical output per unit weight of lead and active material is 50 to 200 per cent higher than that of the standard types, and it is less subject to mechanical defects and variability Batteries may be rebuilt by shipping charged elements wrapped in paper, the separators between the plates not allowing them to dry out in transit

Retarding the Action of Electro-Magnets. — The attraction of an armature by an electro magnet may be retarded by winding a short-circuited coil on the magnetic circuit In order to get the longest retardation the reluctance of the magnetic circuit, the resistance of the short-circuited winding, and the remanence of the iron should be small, states an authority in *Electrotechnische Zeitschrift* This authority has constructed an electro-magnet in which the time lag in its operation may be adjusted from 2 to 8 seconds This device has found practical application in the operation of lighted buoys, so as to give flashes of light at regular intervals.

Mexico's Chihuahua Radio Station.—A combination of radio and radio telephone station will shortly be in operation in the city of Chihuahua, according to Consul J B. Stewart. The station will have a range of 6,000 miles, thus putting Chihuahua in direct communication with all parts of the United States, Europe, and other countries Some time ago an American company contracted with the Governor of Chihuahua for the erection of this radio station, and the manager of the company states that the material and apparatus have already begun to arrive at El Paso, Texas A station will probably be installed at Ojinago and Ciudad Juarez and, later on, at Madera, Chihuahua Steps have also been taken to instal radio communication for certain mining and smelting companies

Finland's Radio Station. — A new Poulsen station for radio telegraphy has been completed at Sandhamn, a short distance from Helsingfors, Finland A 10-kilowatt primary-effect Telefunken radio station has been there for some time, connecting with German, Swedish, Norwegian, Russian, Esthonian and Latvian stations, but the new station is still more powerful and establishes connections with all the principal countries of Europe. Experiments, conducted under direction of the chief of Finland's radio service, have established sharp and clear communication with the English radio station at Poldhu—a distance of some 1,500 miles—and the signals were clearly heard at the English Chelmsford station and the Danish Lyngby station. Connections were also established with the nearer stations at Berlin, Königsburg and Petrograd.

Science

Maps as Paper for Stamps.—Many of the new republics which were a by-product of the war are utilizing all kinds of material for their needs For example, Latvia prints her stamps on the back of maps Paper used for maps is generally good, so the reverse of the sheet makes an excellent white paper for stamps

We Are Now All Counted.—Final statistics placing the total population of continental United States at 105,710,620, or 27,512 more than announced last October, when preliminary figures were given out Final figures place the total population of the outlying possessions of the United States at 12,148,738, which brings the population of the entire country and its possessions to 117,859,358.

How to Find Lost Radium.—A doctor recently threw away a $6,000 tube of radium which became mixed up with some bandages which were consigned to the furnace A radium expert was summoned and he sprinkled zinc sulfide all about the cellar and then turned out the lights Soon the anxious watchers saw a small glowing patch among the ashes in the furnace and found the tube of radium which, by its action, had caused the zinc sulfide to become luminous The doctor will be more careful in future

Now the "Curie".—So far as we can remember only one letter in a daily newspaper called attention to the "curie" which belongs to the family of the watt, the volt, the ohm, the farad, etc. At the International Congress of Radiology which was held in Brussels in 1910, of which Mme Curie was president, it was agreed to call the unit of radio-activity—namely, the amount of radium emanation which is in equilibrium with one gram of radium—by the very appropriate name, the "curie" (As in studying radium one works with exceedingly small quantities, it is the term "millicurie" that is in most frequent use) Thus as long as science lasts will the name of Mme Curie be perpetuated

The "River of Doubt" To Be Cleared Up.—The Mulford Biological Expedition, which will pick up the lost trail of the Roosevelt "River of Doubt," has just sailed The expedition is headed by Dr Henry H Rusby of the Columbia University School of Pharmacy and has among its other members Dr Frederick L Hoffman, statistician and third vice-president of the Prudential Insurance Company, Dr Orman E White of the Brooklyn Botanical Gardens, Dr William M Mann, assistant entomologist of the United States Bureau of Entomology, Dr Everett Pearson, ichthyologist of the Indiana University, and George F McCarthy, expert photographer They will spend two years in uncharted regions and expect to trace the 'River of Doubt' to its source, incidentally collecting fauna and flora, particularly rare plants and herbs for chemists and medical professors

German Casualties. — Germany's casualties in the great war were placed at 6,888,982 by Dr William S Bainbridge of New York, Commander in the Naval Medical Corps, in a recent address at Boston before the Association of Military Surgeons of the United States The figure was determined through two years' service in Germany during the war as an observer and from the study of official and semi-official publications and statements in German, Dutch and Scandinavian magazines The German losses were divided as follows. Killed in battle, 1,531,148, missing, 991 340, wounded, 4,211,481, died of disease, 155,013 It had been absolutely established however, he stated, that 90 per cent of the German wounded were refitted for service in the field or at the base hospitals, or rendered self-supporting. Of the sick and wounded who reached the home hospitals in Germany only 1 6 per cent died

Alcohol from Tropical Jungles.—We clutch at anything as a substitute for gasoline Professor Whitford of the Yale School of Forestry says that alcohol could be economically manufactured from the moist vegetation of tropical forests and jungles "The evidence is conclusive," said Professor Whitford, "That the tropical sun has the power to store up more energy in the form of cellulose in a given time than has the temperate sun If this is in a utilizable form it remains for the ingenuity of man to overcome the difficulties of profitably applying it. With the increasing needs of the nation it is reasonable to expect that sooner or later it will be necessary to utilize more fully the plant resources of the tropics" Professor Whitford said that the annual production of alcohol from the nipa plant in the Philippines was now nearly 3,000,000 gallons and that one distillery there had produced 98 per cent alcohol at a cost of about 20 cents a gallon, and if operated to full capacity could make it at a cost of 15 cents a gallon.

Engineering

Second Simplon Tunnel. — This tunnel, begun in March, 1911, is 98 per cent completed The first tunnel was begun in 1898 and opened for traffic in 1906

Disk Bearings. — What is said to be an entirely new principle in bearing design has just appeared in Great Britain, as the result of prolonged research by the scientific investigators of a leading ball-bearing manufacturer in that country The bearings in this new design are disk-shaped, with rounded peripheries and are said to combine the low frictional resistance of the ball bearing type with the greater carrying capacity of the roller bearing

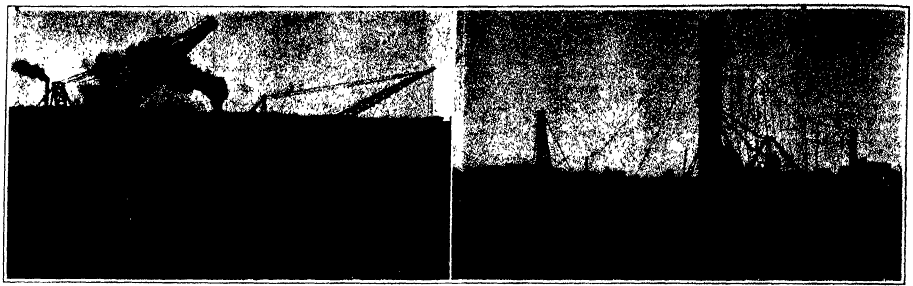
Alberta's Big Projects. — Tremendous irrigation projects are planned in Alberta as the result of the provincial government backing the $5,400,000 bonds of the Lethbridge Northern District, and it is estimated that the total amount of outlay involved in all the proposed undertakings will amount to between $50,000,000 and $60,000,000 This expenditure, of course, does not include the Canadian Pacific Railway's gigantic enterprise which already is serving hundreds of thousands of acres The demand for irrigated land is greater than the supply at the present time, so impressive have been the returns from land furnished with water artificially in Alberta

The Philadelphia-Camden Bridge. — Six roadways are provided in the plans of the bridge to be built across the Delaware River to connect Philadelphia and Camden In addition, there are to be four trolley lines two of which are for high speed service, as well as two ten foot walks for pedestrians An example of the size of the proposed structure may be taken from the plan, which proposes that the east main river tower shall rise 380 feet above the Delaware River The span length on the Franklin Square-Pearl Street location is 1 750 feet between towers The proposed bridge, which will surpass by a good margin any of the existing suspension bridges, is to be described and illustrated in an early issue of this journal

China's Concrete Work. — Owing to the high cost of timber in China, it has been found economical to make railway sleepers and electric transmission line poles of reinforced concrete The sleepers are reinforced with old mine cable, states *Engineering News-Record*, and are cured under water before use New track is not supplied with concrete sleepers, but laid with ordinary wooden sleepers, which are afterward replaced by concrete when the road bed is well settled The poles are 40 feet and 50 feet high, and are cast horizontally They are hollow for four fifths of their length, square section, and taper, and some of the reinforcing rods are carried above and below the pole to act as lightning conductors In both cases the concrete mix is 1 2 4, and the poles and sleepers have given complete satisfaction

Formosa's Hydroelectric Project. — The Jitsugetsutan (Lake Candidius) hydroelectric project to be constructed in Formosa has attracted considerable attention on the part of various purveyors of electrical and mechanical equipment The generating station is to consist of six 20,000 kilowatt alternating-current generator units directly coupled with Pelton type water wheels operating under a mean actual head of about 1,370 feet In addition to the main water wheels and generators, the specifications also call for water-driven exciter units, penstocks, governors, valves, eighteen 7 400 kva step up transformers, switchboard and switching equipment, and other auxiliary apparatus, including a traveling crane For the two substations there will be required twenty-one 7,000 kva step-down transformers three synchronous condensers, and the switching and other auxiliary equipment in connection therewith

Niagara Hydroelectric Canal.—This undertaking is and has been making rapid progress toward completion It has been especially favored by the weather, which made it possible for the work to go on unimpeded during the last winter Of 13,500,000 cubic yards of earth excavation, 12,500,000 cubic yards have already been removed, while of the 4,000,000 cubic yards of stone excavation, 2,500,000 have been taken out This speed in the removal of earth and stone has been accomplished by shovels which excavate 8,500 cubic yards of earth or 3,000 cubic yards of stone in 20 hours with two shifts of men These shovels handle 8 cubic yards of earth or 6 cubic yards of stone at a time The deepest cut in the canal is 135 feet There are now, and have been during the past winter, 7,200 men working on this job To house the workmen it has been necessary for the Hydroelectric Canal Commission to construct many buildings, as it has been impossible to get adequate housing accommodations in the city of Niagara Falls, Ont



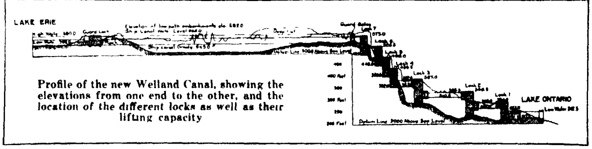
Left. Drag-line excavating machines working on dam at head of Lock No 6 *Right:* Breast-wall of Lock No. 2 looking southeast, showing sheet-steel piling.

Construction work now going on in connection with the Welland Canal

Canada's Great Ship Canal

The Present Status and the Ultimate Plans of the Welland Improvement

By J. F. Springer



Profile of the new Welland Canal, showing the elevations from one end to the other, and the location of the different locks as well as their lifting capacity

PROBABLY the greatest engineering enterprise being prosecuted in the New World is the $100,000,000 ship canal now under construction between Lakes Erie and Ontario About one fifth of this sum has already been expended, so that the work is far from being completed It is not going on at a fully satisfactory rate because of lack of coal and Portland cement Construction work was, naturally, interrupted by the Great War, and now it lags because of the legacies from that same war However, the great work is going on and may be expected to gain momentum

It seems that 140,000 barrels of cement were wanted for 1920, but that this requisition was ultimately cut down to 30,000 It is doubtful if even this has been supplied Soft coal was, some time ago, being picked up in odd lots at $14 to $15 per ton These are serious handicaps, but they will shortly be forgotten, no doubt, and the work pressed on with full vigor

The New Welland Canal is the most expensive link in connection with the development of a passageway for ocean-going ships from Lake Superior to the Atlantic The five Great Lakes have the following average levels above the sea Superior, 602 feet, Huron and Michigan, 581 feet, Erie, 572½ feet, Ontario, 246 feet The St Lawrence, a notable river, takes care of the further drop to the ocean itself

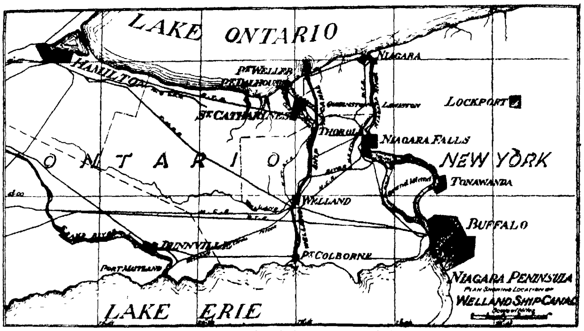
There are three principal difficulties in the way of providing a continuous ship channel all the way from Duluth to the seaboard One is at Sault Ste Marie Here there are already locks on the United States side which provide for the drop between Lakes Superior and Huron, in so far as ships drawing less than 24½ to 26 feet of water are concerned. Another difficulty centers on the great drop of 326½ feet between Lakes Erie and Ontario Then there are the faulty arrangements for passing ships through the six canals which make the upper St Lawrence a navigable stream These canals are provided with locks that have only about 14 feet of water on their sills, and are otherwise inadequate

To secure a 25 foot channel, reaching from Lake Superior to the Atlantic Ocean will however require only the completion of the present plans for the Welland Canal and of some adequate scheme for the proper development of the six canals between Lake Ontario and the harbor at Montreal In fact, the present design of the locks for the Welland waterway provides for 30 feet of water on the sills, so that, if the St Lawrence locks are similarly constructed a 30 foot channel from Duluth to the sea will require only some comparatively inexpensive construction at Sault Ste Marie and some not especially expensive dredging jobs, principally in the Welland Canal and in the six canals of the St Lawrence The route from Montreal to the ocean has plenty of water and is navigable for eight months of the year

The New York Barge Canal connects up existing waterways and thus makes it possible to ship unbroken cargoes between Duluth and tidewater at New York City, but reloading must take place at the latter point for cargoes brought in or taken away by ocean-going ships The locks of the Barge Canal are provided with but 12 feet of water on their sills, which is a limitation sufficient to bar the passage of the representative ocean-going vessel. As compared with the ultimate Canadian scheme, the New York Barge Canal has one disadvantage—that of reloading. But the Welland Canal on the basis of an undeveloped canal system on the St. Lawrence will be subject to pretty much the same limitation, as through shipments from the West of considerable cargoes will have to terminate at the eastern end of Lake Ontario.

The Welland Ship Canal cuts across the Niagara Peninsula, which is Canadian territory lying between Lakes Erie and Ontario The trench lies well to the west of Niagara Falls, but it has to pass the same ledge and effect the same drop as the great falls and its rapids Altogether, it effects the change of level of, say, 325½ feet by a series of but seven or eight locks This is a great improvement over the old Welland Canal with its 25 locks The new canal coincides in the main with the old route. There are, however, four points at which the new line of the waterway effects reductions in length by following a more direct path. In fact, the new canal follows a line with no substantial kinks in it—a reasonable approximation to a straight line The standard locks are all located in the northernmost third of the canal—that is, between the town of Thorold, Ont, and the Ontario terminus. The seven of them are numbered south from this terminal The longest stretch clear of locks in this northernmost third of the waterway is the almost straight reach between locks 2 and 3 After passing lock 7 on the way south, there is an almost uninterrupted passage into Lake Erie. However, omission must not be made of the guard lock near the town of Humberstone and perhaps 8¼ miles from the Lake Erie terminus. This special lock has the following purpose:

The Great Lakes, even if they were connected by clear, natural passages, would not all be at the same level. This is true apart from the consideration of such an abrupt change in the basin level as occurs with Lake Ontario. The Great Lakes form, in fact, a



Course of the old and the new Welland Canal mighty, though slow moving, stream with the St. Lawrence as the outlet. Naturally, this stream flows downhill, and one is to expect changes of level for that reason. Then the effect of winds must be taken into account. In short, Lake Erie, at its eastern terminus has, so it appears, a variation between extreme high water and extreme low water amounting to 11¾ feet. That is, the water entering the canal at the Lake Erie terminus may have a level of 568 feet above sea level, or one of 579¾ feet. The guard lock will have the duty of enabling vessels to pass, whatever the conditions on Lake Erie happen to be. There may at times be nothing for it to do. This condition will occur at extreme low level on Lake Erie. That level is adopted as the summit level for the canal and is the one at which the long stretch from the guard lock to lock 7 will be operated. If the water in Lake Erie has a higher level, then the guard lock will have to pass the vessel up or down for the excess. The mean level in Lake Erie is 572½ feet, so 4½ feet is to be regarded as the average lift.

A little consideration will perhaps show the reader that any abrupt changes in level on Lake Erie might result disastrously for the canal, unless such changes were anticipated in the design and adequately provided for in it. The guard lock is located in one of the sections where the new canal is freshly located. To the east is an angular bend forming part of the present Welland Canal. This old section of trench is to be preserved and used as a kind of by-pass. Near its center is located a weir whose duty it will be to restrain and regulate the passage of water. It will now be understood, perhaps, that water flowing north from Lake Erie will enter both the new and the old channels at a Y south of the guard lock and the weir. The weir will be operated to pass just the right amount of water to maintain the long stretch to lock 7 at the required normal level of 568 feet above the sea. If one counts the guard lock, the canal has, of course, 8 locks in all.

The construction of the canal from the guard lock to lock 7, a distance of about 16 miles, is largely a simple excavating proposition. There are elevations along the route. These must of course be cut away, even where the work is already partially done because of the coincidence between the old and new canals.

At Thorold, toward the north, the country drops off in level to the amount of perhaps 190 feet in a distance of 1 mile. Here are located four locks in all, three of them being twin locks in flights The change of level of the canal surface amounts to 186 feet, or just four times 46½. In fact, all seven of the standard locks effect a uniform change of 46½ feet per lock The total thus amounts to just 325½ feet

The almost completed Lock No. 1, looking north

However, the lift effected by lock 1, near Lake Ontario, will vary from the standard 46½ feet down to 40 That is to say, 825½ feet is the difference in level between the two lakes when extreme low levels (568 and 242½) are made the basis of the estimate But Lake Ontario, like Lake Erie, passes from an extreme low level to an extreme high level (249) The higher the water in the lake, the less will be the lift required at lock 1. Implied in the foregoing is the fact that the canal level from this lock on to the northern terminus is to be at the lake level, and will vary with the latter

While the locks provide for 30 feet of water over their sills, this depth of channel is not maintained in the canal prism itself. Here the 25-foot depth reigns In order to provide for this 25-foot depth, something like 29,000,000 cubic yards of rock and earth remain to be excavated, according to a statement published in September, 1920. Concrete to the amount of 2,000,000 cubic yards is yet to be poured According to the same estimate some 1,400,000 cubic yards of watertight embankment are still in the future.

Naturally, a very large part of the concrete is to go into locks. The sides of a typical single lock are formed by vertical faces of gravity-section walls These are of concrete, as a matter of course The section is narrow at the upper part where little or no hydrostatic pressure exists, the inner and outer faces being parallel Below, the section is stepped on the rear These side walls are filled in, on the outside, with earth and the like. The concrete floor is somewhat concaved on top and is a simple slab tied to the underlying rock with 2-inch rods, making a rigid construction.

The Thirty-Degree Pile Driver

THOUGH not much fuss is being made about it, the fact remains that one of the world's big canals is being constructed in the vicinity of New Orleans, La. the world's big canal is to cut down the distance from the Gulf of Mexico to the city by having the vessels routed through the canal and Lake Pontchartrain A saving of half the distance now traveled will result from the use of this canal

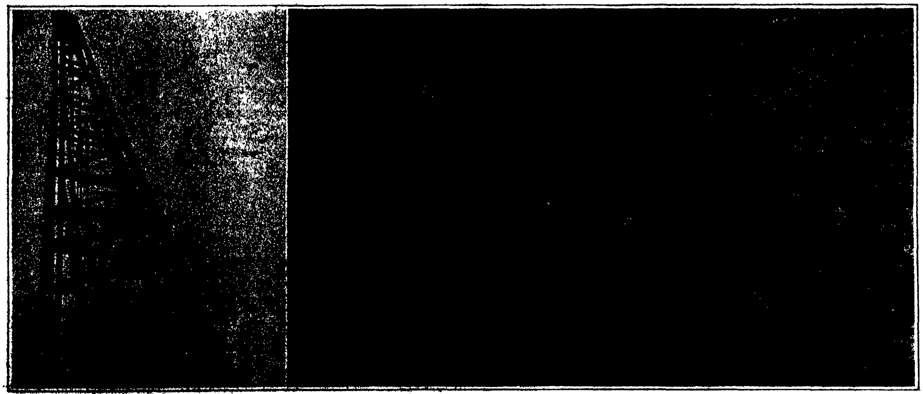
The territory through which the canal is being built is not at all of the character best suited for the concreting which is part and parcel of present day canal building. In fact, the foundation is so insecure that it has been found necessary to drive a vast number of piles Even the driving of piles was found to be insufficient and instead of driving them in the vertical and most common way the engineers have decided that batter piles will be more suitable

Accordingly they have erected a number of the pile-drivers shown in the accompanying photograph A first glance will reveal nothing out of the ordinary to the uninitiated, but closer observation will disclose the fact that this pile-driver has, in reality, two complete sets of driving gears, operated by the same engine.

Piles may be simultaneously driven vertically and batter It will be noticed that in place of the ladder, which is generally found on the angular side of a pile-driver, we find that a running gear for the obliquely-running pile-driver hammer has been substituted and the ladder is broken into a number of sections which are plainly visible

A very fair idea of the number of piles necessary for this particular project may be had from the photograph taken in the vicinity of the lock where the height of the concrete to be poured made a more firm foundation essential Piles, both vertical and batter, are here shown before they have been cut off In this picture may also be seen the hammer on the vertical side of the driver, which is resting on the head of a pile At one stage of the work nine pile-drivers were in operation in a comparatively small space. Approximately 16,000 piles were driven in the lock site with 12,500 piles acting as foundation piles for the locks proper The remaining piles were used for supporting the runways, trestles, etc.

The driver of the batter type, such as shown in the photographs, drives piles at an angle of thirty degrees, considerably greater than the angle which is possible with an ordinary moon-beam driver


The pile-driver with two runways and two hammers, which drives piles vertically and at a thirty-degree angle; and a nest of piles, including both sorts, put down by it in the lock basin of the Pontchartrain Canal

The train of seventy 100-ton coal cars, which was taken down the heavy grades between Bluefield and Roanoke under perfect control

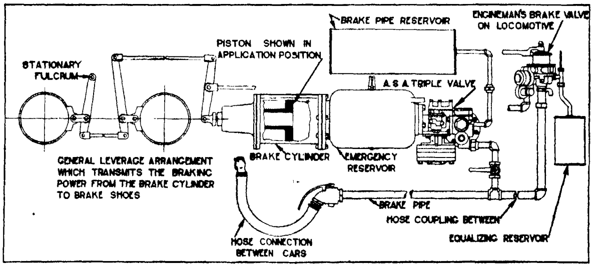
Improvements in Train Braking

A Combination of Straight and Automatic Air That Gives Remarkable Brake Control on Steep Grades

ALTHOUGH American railroading has been developed to a pitch of excellence which causes us to feel a justifiable pride, the inventor-engineer is still busily at work upon improvements, and in the accompanying illustrations we show what has been done of late years to secure a more complete solution of the important problem of controlling safely by brake the speeds of heavy and fast trains The latest development in this direction is what is known as the automatic straight air brake Recently, with a view to giving this type an extremely severe test, a coal train made up of seventy 100-ton coal cars and weighing with its engine and cabooses, just under 9,000 tons was taken down the well known grade from Bluefield to Roanoke on the Norfolk and Western Railway, and held under perfect control by the engineer

The Brake Equipment on the Engine

The brake equipment of a train is illustrated by the equipment for the engine and one car shown diagrammatically in the accompanying cut Briefly stated, it is as follows On the engine are one or two air pumps, which maintain a predetermined pressure of from 90 to 130 pounds per square inch in a main reservoir, which is also located on the engine The main reservoir carries a reducing valve, and from this valve a brake pipe extends throughout the whole length of the train from engine to caboose The reducing valve is designed to maintain a predetermined pressure in the brake pipe of from 70 to 110 pounds for passenger and from 70 to 90 pounds for freight trains The brake pipe connection from engine to train and between cars is made by a flexible hose connection On its way from the main reservoir to the train, the brake pipe is led up to an engineman's brake valve which is located conveniently to his hand By manipulation of the valve lever, the engine man can allow a portion of the air to escape to the atmosphere, thereby lowering the pressure in the brake pipe, the degree to which the pressure is lowered depending upon the extent to which he opens the valve The portion of the equipment above described is shown at the extreme right hand of diagram, marked "Engineman's Brake Valve."


BRAKE PIPE RESERVOIR
ENGINEMAN'S BRAKE VALVE ON LOCOMOTIVE
PISTON SHOWN IN APPLICATION POSITION
STATIONARY FULCRUM
A.S.A. TRIPLE VALVE
GENERAL LEVERAGE ARRANGEMENT WHICH TRANSMITS THE BRAKING POWER FROM THE BRAKE CYLINDER TO BRAKE SHOES
BRAKE CYLINDER
EMERGENCY RESERVOIR
BRAKE PIPE
HOSE COUPLING BETWEEN
EQUALIZING RESERVOIR
HOSE CONNECTION BETWEEN CARS

Diagrammatic view of the automatic straight air equipment

The Brake Equipment on Each Car

The remainder of the drawing shows the brake equipment as it is installed on each individual car, whether freight or passenger It consists first of a brake pipe reservoir which is charged through the brake pipe with compressed air at the brake pipe pressure and for normal operation of the train, or for what is known as service stops, air is led from this reservoir to the brake cylinder, the movement of whose piston under this pressure serves to apply the brakes There is also an emergency reservoir which is also maintained at the maximum brake pipe pressure and this reservoir is drawn upon when it is desired to apply the brakes with maximum power for the quickest possible stopping of the train Lastly, and most important of all is an exceedingly ingenious mechanism known as the triple valve, which controls the supply of air to the brake cylinder and determines the pressure with which the brakes shall be applied throughout the train.

The Triple Valve

It is the triple valve that has made possible the operation of the automatic brake Without this valve it would be impossible to make the instantaneous application and release of the brakes which are necessary to the successful handling of a long train It will be evident that if there were no reservoirs on the cars, and the brake pipe conveying the air pressure from the main reservoir on the engine were connected directly with each brake cylinder, it would be impossible for the engineer to make a simultaneous application of all the brakes throughout the length of a long train; for the cars nearest the engine would get the pressure first, and it would take time to build up sufficient pressure for the desired application on the rear cars Hence, the necessity for an independent pressure reservoir on each car, provided with its own pneumatically-operated valve, which responds instantly to the operation of the engineman's brake valve on the locomotive The triple valve enables the engineman, so to speak, to place his controlling hand at once upon every car in his train

It is impossible within the limits of this article to explain the automatic straight air triple valve in detail, but it is sufficient to say that it contains certain valves which control the admission of air from the brake-pipe reservoir and the emergency reservoir to the brake cylinder, and that these valves are themselves controlled by the manual manipulation of the engineer's brake valve The automatic straight air triple valve is more positive in its action than previous triple valves because the actuating pressures acts on a series of balanced metal diaphragms which are extremely sensitive to any variation in pressure, and, since the variations in brake pipe pressure are controlled by the engineman's brake valve on the locomotive he is able, by opening his valve and lowering the brake pipe pressure, to cause an immediate functioning of the triple valve and an immediate application of the brakes on every car throughout the train. Moreover, due to the peculiar construction of the automatic straight air valve, it is possible to secure a predetermined pressure in the brake cylinder *and maintain it constantly throughout the application.*

Long Trains Complicate Braking

The development of the straight air brake was due to complications which arose from the continual increase in the length and weight of trains Unless both the application and the release of the brakes are fairly simultaneous throughout the train, and unless the brake pressures between shoe and wheel are fairly even and constant, heavy dynamic stresses will be set up in a long train, which often reach a point at which they become destructive If the brakes take hold too slowly, from the engine toward the rear, the rear cars will crowd up against the forward cars on which the brakes are already acting, and the accumulated pressure may become great enough to buckle the train, throwing the cars on to adjoining tracks Conversely, if there is delay in the releasing of the brakes, and the release takes place in the forward cars before the after part of the train has let go, the momentum of the engine and the forward cars may prove sufficient to snap the couplings somewhere toward the middle of the train Both of these forms of mishap have been a fruitful cause of freight train smash ups

Maintaining Uniform Brake Pressure Throughout Train

Not alone is it desirable to secure simultaneous application of all brakes throughout the train, but the brake cylinder pressure should be uniform. If it varies, some cars being strongly braked and others lightly, there occurs a jerking or surging action, which is exceedingly annoying in passenger trains, and positively destructive in long freight trains In the brake under consideration, simultaneous action is secured through the great sensitiveness of the diaphragm in the triple valve; and the peculiar construction of the same valve makes it possible to secure an even brake pressure on all the cars, no matter what the length of the train. Thus in setting the brakes, air is fed from the brake pipe reservoir to the brake cylinder at a predetermined pressure. The air causes the piston to travel forward, or, as in our diagram, from right to left, until the brakes are set. If the travel of the piston were uniform and there were no leakage past the piston packing, the admission of a given amount of air at a given pressure would result in a uniform pressure of the brake shoes on the wheels; but, due to the difference in wear of the brake shoes and the brake rigging, there is a variation in the slack which has to be taken up, and the travel of the brake cylinder piston is not the same in all the cylinders Some may travel forward six or seven inches and others as much as ten or eleven inches, before the brakes are driven home. But since the pressure of the air admitted to the cylinder will vary inversely as the volume, that is, inversely as the travel of the piston, it follows that there will be a variation in the brake pressure on the various cars. Also, leakage past the piston packing will be more in some cylinders than in others, and this will result in various brake shoe pressures.

Now, the construction of the automatic, straight-air, triple valve is such that it secures and maintains in the brake cylinder a predetermined pressure independently of the travel of the piston. It is so set that if the engineman reduces the brake pipe pressure, say from 70 to 60 pounds, the brake cylinder pressure will

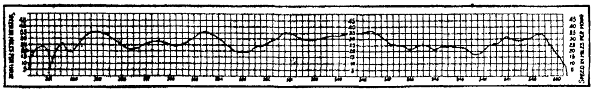
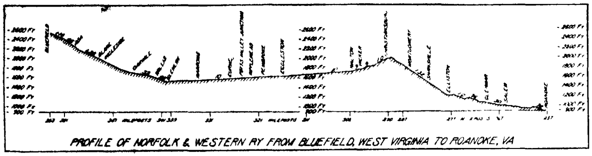


Diagram showing the speed of the train

be two-and-a-half times the reduction, or 25 pounds. Should the brake gear be slack and the piston travel long, or should there be excessive leakage past the piston and the air pressure tend to drop below 25 pounds, the triple valve will function, admitting sufficient air to maintain the pressure always at the desired amount of 25 pounds. In this way, there is maintained a practically even braking pressure which, as shown in the handling of the 9,000-ton train above referred to, is independent of the length of the train, and makes it possible for one engine to take trains of unprecedented length and weight down heavy mountain grades and keep them under perfect control.

It should be noted that with the A.S A brake it is possible to obtain an emergency application with full emergency cylinder pressure under any conditions, no matter whether the brakes have just been released after a service application or partially applied. With this system, with its constantly-maintained and easily controlled brake pressures, there is no call for frequent service applications on down grades and consequently there is a great economy of air supply. Furthermore, the sensitiveness of the valve is such that if, through leakage, the brake pipe pressure has fallen to a dangerous degree, the triple valve will operate and cause a full emergency stop. In this connection it should be mentioned that if through accident, the angle cock shown in our drawing near the hose connection should be shut, cutting off the engine main reservoir from the train, the gradual leakage of air in the brake pipe will cause the triple valve to function and effect an emergency stop.



This shows the heavy grades with a maximum of 1.32 over which the test was made

Controlling a 9,000-Ton Train on a 1.6 Per Cent Grade

A test of this brake was made recently, when a train of seventy 100-ton coal cars, weighing, with engine and caboose, 9,000 tons, was handled down a series of grades between Bluefield and Roanoke, on the Norfolk and Western Railway In addition to the photographic illustrations we present two diagrams, one showing the profile of this section of the line, and the other the speed in miles per hour developed by the train. These diagrams speak for themselves Next to the engine was a dynamometer car in which individual pens recorded the brake cylinder, brake pipe and auxiliary reservoir pressure, the brake application on the first, twenty-seventh, fifty-third and seventieth cars, the drawbar pull of the locomotive, speed and other data Trainographs also were placed on various selected cars from the first to the last, which made automatic records. Although the engineer who handled the train had had no experience in the operation of the automatic *straight* air brake equipment previous to the test run, he held this heavy train entirely under control throughout the run without any jar that was perceptible to the expert trainmen and representatives of railway journals who were riding on the top of the last car. It is significant, as showing the economy in the maintenance and use of the air supply, that, although the engine was equipped with two sets of air pumps, one of these proved ample to maintain the supply.

The dynamometer of the train where pens made automatic records of brake cylinder and other pressures, brake application on selected cars, drawbar pull, etc.

New Insulating Material

THE black volcanic rock known as basalt is an extremely fine grained stone which is more difficult to crush than granite and wears better than that stone. In those localities where it is found, as in the United States, in Scotland, in Rhenish Prussia and in France, it is employed in the form of flags for sidewalks, stepping stones, etc, as well as in the form of chiseled blocks for making bridges, sustaining walls, etc. It is also extensively used to make macadam roads. It is found abundantly in the French province of Auvergne and this is why the best roads in France, long famous among automobilists, are found in this region But the great hardness of the stone, and the difficult and expensive process of chiseling it into shape, has hitherto greatly restricted its use

This difficulty has now been overcome by the successful experiments which have been conducted for some years by Dr Ribbe of Mauriac in Auvergne As long ago as 1909 this savant succeeded in showing that basalt could be fused and molded without much trouble at a temperature of 1,300° C Unfortunately the product obtained, a jet black vitreous substance, and was so fragile as to make it unsuitable for most purposes Like glass it was too readily shattered to be employed as building or paving material It then occurred to Dr Ribbe that it might be possible to *devitrify* the molded articles in such a manner as to reconstitute the crystalline structure of the original rock This he finally succeeded in doing after extended experiment under the auspices of a company especially formed to exploit this new material and called "*Le Basalte*" Dr Ribbe's investigations, which were interrupted by the war, have had the result recently of establishing some interesting new characteristics in basalt which has undergone this process.

Most remarkable among these is the high electric resistance exhibited by this new material, a property in which it is equal or superior to all known insulators An especial advantage in this connection is the possibility of dispensing with cement for attaching the metal armatures of insulators, since these form a perfect union with the basalt if placed in it while it is in a pasty condition Undoubtedly fused basalt will henceforward be widely employed for making insulators for the third rail, overhead and underground wires, etc

Another marked advantage of the fused basalt is the very great resistance it offers to wear and tear and to crushing—a resistance which is superior even to that of the natural rock For this reason the experiments which have already been made with it for paving much traveled roads in the vicinity of Paris and for factory yards, etc, have met with great success, as was to be expected It is believed that it will prove admirable in the construction, not only of supporting walls and piers, for corner stones and key stones, but also in construction of magnificent buildings, monuments, and other works of art, not only because of its wonderful durability but because it can be furnished in forms as regular as those of ordinary bricks and tiles

Another virtue it possesses is the fact that it is not attacked by acids, a circumstance which extends the probability of its use in chemical works and places where ordinary stone is greatly ravaged by acid fumes as well as by the effect of the weather.

Finally, it can be prepared for roofing material by having air blown through it while in a molten condition, so as to make it porous like natural pumice stone

Markets for Applewood

IT will seem incredible to the layman that applewood has considerable value as lumber, that it is actually cut for such, and that one firm alone uses upward of a million feet a year The layman thinks only of the fruit in connection with the apple He forgets that the apple is a native American forest tree, and that in many country sections it still grows wild These trees are known locally as "natural fruit" trees

The native wild apple, in particular, is a tree with sterling qualities of wood The wood is tough, hard, strong The tree itself grows to great age The craftsman in wood finds applewood one of the very best for special purposes, one of which is tool handles. The tool handle market is the one the farmer shipping apple lumber caters to

Apple lumber is sold by the cord The usual specifications stipulate sound logs at least twelve inches through Right here, the limited production of apple-lumber is hinted at Old apple trees very often have unsound trunks Under the most favorable and exceptional conditions, only a few logs can be obtained from a single tree The farmer consequently sells apple lumber in an incidental, occasional way

On any of our old farms an abandoned orchard may produce several cords A pasture may afford several mammoth trees Market prices vary One farmer has marketed apple lumber within the past year for $40 a cord, delivered to mill.

The makers of tool handles, however, are not the only buyers of apple wood In some ways, the other open market interests most farmers The apple tree trunk fitted up into large chunks makes magnificent fireplace wood There is "life and last" in it, as the farm family puts it There is a New Hampshire farm which for years has shipped apple fireplace fuel for two Boston hotels Sold for fuel, apple lumber brings less than for tool handles, but the qualifications are not nearly so hard to meet Many an old trunk useless for the mill is tip-top for the fireplace.

Pursuant to the series of illustrations which we have presented of the Hudson River Bridge, we show in this issue a very finely executed perspective view taken from a point to the northeast of the New York anchorage. It will be agreed that the architect has executed a very successful treatment of this great mass of masonry, with its superincumbent office building, and that it harmonizes perfectly with the main tower of the bridge beyond it. The dimensions of the anchorage on the ground plan are 350 feet by 400 feet, and its height above ground level is 220 feet. Through this block of masonry flows the whole traffic of the bridge. The motor cars and motor trucks pass through a noble arch, 135 feet in span by about 60 feet in height. The trolley-car and foot-passenger traffic will make use of two side arches, 45 feet in width. On the deck below will be six pairs of steam railroad and rapid transit tracks. The motor-car and foot-passenger traffic will enter and leave the bridge by easy curved approaches at Eighth, Ninth and Tenth Avenues. The last named avenue is shown in the foreground of this picture.

THE NEW YORK APPROACH TO THE HUDSON RIVER BRIDGE, SHOWING THE MASSIVE ANCHORAGE, WITH OFFICE BUILDING SUPERIMPOSED

How the Lower Animals See

Old and New Ideas on the Function and Operating Details of Insect Eyes

By William Crowder

THE eyes of insects and other invertebrate animals have always been an object of curiosity, not only to the layman but to the scientist as well. Nature seems to have been peculiarly subtle when she endowed this portion of the animal kingdom with organs of sight; for, as will be shown later, besides giving many of these creatures eyes wherewith to see, she placed in their possession an instrument, the performance of which is equaled only by a good magnifying glass. Many ingenious theories have been proposed in the past regarding the exact functions of both the compound and the simple eyes of the lower animals, but recent research has thrown much interesting light on this subject, and as a consequence some of the most firmly established theories—theories supported by very weighty evidence—seem to be losing ground.

It is the large compound eyes which by their prominence and configuration usually attract the attention of the observer. The structure of these organs is essentially the same in all animals possessing them, and externally the eyes are always marked by minute divisions of hexagonal facets. Each of these facets, however, is the covering of a unit which is a complete eye in itself, and it is the fusion of many of these units which constitute the whole—or makes as the term applies—the compound eye. In an ideal, or free, state these facets would be circular, but they have assumed their hexagonal shape from compression. In substance they are composed of the cuticle, specialized merely by being made transparent, this specialized cuticle being called the cornea or external layer. Behind the cornea is what is called the cone, or crystalline lens; and it is this structure which forms the image perceived by the animal. In some insects, however, this cone is not present, and as a result they can distinguish little but light and darkness. The apex of the cone is terminated by a rod which is surrounded with nerve fibrils arising from the optic nerve; and both the cone and the rod are invested with an opaque pigment which prevents the rays of light from passing or diffusing from one facet-eye to its neighbors. If we take an exceedingly thin section cut in a vertical plane, as prepared for the microscope, it will be seen that the contiguous cones are arranged in a radiate manner—their bases united with the cornea and their apices with the ends of the optic filaments

Now the fact that each facet-eye is a complete organ of vision in itself gave rise to a view which, until recently, was held in much favor This view is known as the "mosaic theory" It was maintained that as each cone was separated from its fellows it therefore received a distinct portion of an image In other words, there were as many parts of an image received as there were cones receiving them, consequently a mosaicwork-like impression was received from without It has been shown, however, that this is not the case For, while the foregoing theory was justifiable in that it proposed what was probable in a physical sense, there is no good evidence that the brain of the animal receives a patchwork impression with its many eyes any more than higher animals see a double picture with their paired organs of sight.

Many insects have a field of view equaling about half a sphere, and therefore can see objects lying in nearly every point of the compass. On the other hand, there are some whose eyes have little, if any, convexity, consequently their visual aspect is very limited. The range of field depends upon the form of the eye; the outermost cones marking its limits.

In this connection it has been suggested that in the case of insects the inability to turn the eye is compensated by the number of facets pointed in all directions. Thus, it is claimed, these animals have, in a manner, a distinct group of eyes for surrounding objects.

Yet it seems doubtful whether the compound eye has acquired its characteristic structure by reason of this disability. For notable exceptions to this assumption can be found among the stalk eyed crustaceans wherein compound eyes are anything but immobile. Indeed the facility with which those creatures can direct their eyes far exceeds even that of humans

The size of the facets in different animals varies considerably, and appears to be proportionate to the size of the animal Thus those of an ant are much smaller than those of a dragon-fly Perhaps the greatest number is contained in the eye of the convulvulus hawk-moth—reaching the enormous total of twenty-seven thousand The butterfly has seventeen thousand, the house-fly four thousand, the ant fifty, and the silver fish, that pest of the housewife, has the exceedingly small number of twelve

It is a well known law of optics that the greater the curvature or convexity of a lens the shorter is its focus This, translated in terms of magnifying power, is only another way of saying that the shorter the focus of a lens the greater is it magnification That is to say a lens which has a focal length of one inch will magnify an object to a much greater degree than a lens of which the focal length is twelve inches Moreover, it will be apparent from this that the shorter the focal length the smaller must be the size of the lens. Again, over and above the foregoing, it may be stated that the sole principle involved in seeing an object magnified is that of shortening the distance between the object and the eye For illustration it may be stated that the normal human vision is ten inches An object at that distance from the eye is seen at its natural size If we bring it closer it appears to increase in size—or, is magnified—but due to the inability of the light rays to enter the eye in a direct path, it appears diffused To overcome this we can employ a lens, or we can dispense with a lens and utilize a card with a pinpoint perforation in it By looking through this small hole the field is darkened but the object can be brought very near to the eye and as a result will appear sharp

(*Continued on page 518*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The "Bacon" Manuscript

To the Editor of the SCIENTIFIC AMERICAN:

The treatment of the Voynich manuscript and Professor Newbold's effort to decipher it in your issue of May 28th seems to me in the main eminently sane and sound. I cannot, however, subscribe to the statement on page 432 that "the very facts that the script is a cipher, that the subject dealt with is certainly of a scientific or pseudo-scientific nature, and that the work may with certainty be dated in the 1300's, suffice to indicate strongly the Baconian origin." What proof is there that Roger Bacon was especially inclined to write in cipher? In *Science*, Vol. XLII, 1915, pp. 799-800, I refuted Colonel Hime's attempt to prove Roger the inventor of gunpowder by use of a cipher. As for the scientific or pseudo-scientific nature of the subject, Mrs. Dorothea Singer has prepared a catalogue of some 30,000 scientific or pseudo-scientific manuscripts in British libraries alone; and in a History of Magic and Experimental Science to 1327 A.D. which I hope to publish soon, pages 884-1368 of the typewritten manuscript deal with the twelfth century and pages 1369-2230 with the years 1201-1327. There were many other writers on scientific and pseudo-scientific subjects than Roger Bacon in the thirteenth century and many anonymous collections of "Experiments" and "Secrets," both medical and biological, chemical and magical.

Western Reserve University. LYNN THORNDIKE.

Plant Pigments and Camouflage

To the Editor of the SCIENTIFIC AMERICAN:

It has occurred to me that your readers might be interested in an explanation of the phenomenon on which the detection of camouflaged foliage is based. The methods used during the war were described in the SCIENTIFIC AMERICAN of February 26th under the title "Chemistry in Camouflage."

The starting point for the construction of the light filters is the fact that natural green foliage reflects both red and green light so that foliage viewed through a light filter, which transmits green very little and red a great deal, will appear green, while green paint which reflects only green light will appear green through such a filter

The basis of the double light reflection by green foliage is the fact that the so-called chloroplastids contain both green pigments and orange-to-reddish pigments Two true chlorophylls are known, called a and b, respectively. One is more bluish-green than the other. The orange-to-reddish pigments, which are masked by the chlorophylls, except in autumn when the chlorophylls disappear, are called carotinoids. There are several carotinoids in the chloroplastids; the more reddish one, called carotin, is a hydrocarbon, and also causes the color of carrots, from which it was first isolated. There are several orange-to-yellow carotinoids present in the plastids They are called xanthophylls and are oxyhydrocarbons, very closely related chemically to carotin. The quantitative ratio of xanthophylls to carotin in the chloroplastids is about 2:1, and the ratio of the chlorophylls collectively to the carotinoids is about 5 or 6:1

Since the basis of the camouflage detection is the presence of a mixture of pigments in the chloroplastids, it is possible to construct camouflage which cannot be detected by the light filters.

I am informed on good authority that the gelatin sheets stained for detecting the camouflaged foliage were worked out for the army and navy by the Physics Department of the Research Laboratory of the Eastman Company.

I may say that it is the plant pigment phase of the phenomenon which interests me particularly. I have worked with these substances quite a bit and have published a number of papers about them, especially as to what happens to them when human beings and animals consume foods containing them. Botanists thoroughly familiar with plant pigments would probably have only a passing interest in the above remarks for the explanation which I give would be obvious to them if they gave it a moment's thought. I find, however, that very few people know anything about plant pigments. As a matter of fact, the physicist in charge at the Research Laboratory of the Eastman Company informs me that the initial work in making the camouflage-detecting light filters was apparently based on an old physical observation that green leaves reflect a relatively large amount of red light The whole proposition of camouflage foliage detection only came to my attention shortly before I saw the little article in the SCIENTIFIC AMERICAN My familiarity with the plant pigments permitted me to see at once the fundamental explanations of the phenomenon In fact, I might confess that I was rather pleased to learn that some "scientific friends of mine," so-to-speak, had played their little part in winning the war

LEROY S PALMER

Assoc Prof of Agr Biochemistry
University of Minnesota

The Engine as a Brake

To the Editor of the SCIENTIFIC AMERICAN:

In issue of May 21, p 408, col 1, you state in paragraph with title "Using Engine as a Brake" that no harm will result from using the method given I wish to take issue with this statement as this method greatly increases what is termed "crankcase dilution" This is the result of particles of the gasoline working down the cylinder valves and mixing with the lubricating oil and impairing its lubricating properties This is one of the problems which is receiving considerable attention of both the designers and builders of cars, and is one of the causes of both excessive bearing and cylinder-wall wear.

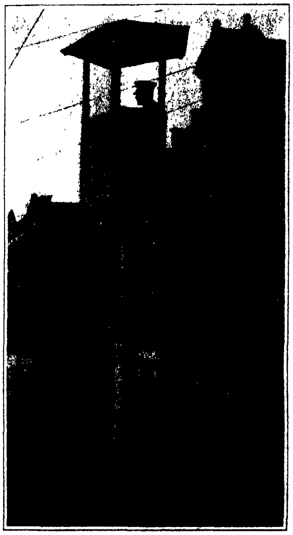
Kokomo, Ind. J. ARTHUR GLATTBY

[*One of our staff who drives the common four cylinder variety of car suggests that with this car at least a further drawback to using the engine as a brake is the rapidity with which this wears down the slow-speed transmission bands One can manage well enough for a reasonable distance with the hand-brake if the foot-brake bands are worn down past the point of engagement; but in the sort of driving that calls for extensive coasting, the slow speed will probably have to be called upon in going up some of the hills If it won't take hold, or if it takes hold only after extensive slipping, this is a more serious matter than a foot-brake that refuses to catch With this engine, too, it appears that under use as a brake the cylinders very soon develop the degree of heat necessary for explosion of the charge without a spark. The braking capacity of an engine that, instead of being driven by the car is functioning as a Diesel engine, is not very marked*—EDITOR.]

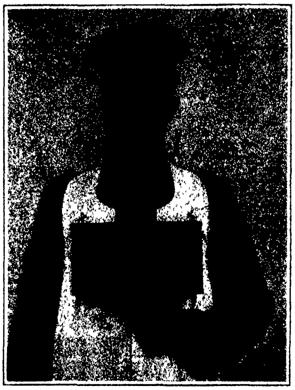
Tricks of Traffic Control

Some of the Ingenious Devices and Interesting Methods Employed at America's Busy Corners

The searchlight signal used in directing Philadelphia traffic at night



Knoxville's traffic tower, in which the officer has all the comforts possible

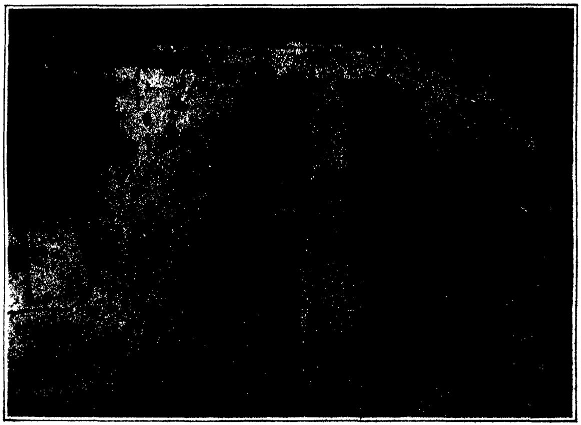


New York's illuminated traffic officer, who can give signals visible at night

SO long as we have cities and automobiles we shall have the traffic officer and the traffic problems that have given rise to this new phase of police activity And so long as we have these problems we shall doubtless have new inventions and new suggestions dealing with them.

One of the most enterprising of our municipalities in this respect is Philadelphia Particularly should the city of brotherly love be complimented for the manner in which it makes its "house rules" clear to the motorist from out of town. The present writer lives within fifteen miles of Newark, and gets into that town with his car more or less often, but he has not solved all its puzzles and does not expect that he ever will. There are still many corners here where he is in doubt whether he may make a left turn or cross the trolley line; and there is in no case a sign informing the driver on these points His first intimation that he is not playing the game according to the rules usually consists in a raucous bawling out from the nearest officer

In Philadelphia it is done otherwise All the way down Broad Street one finds signs, large and prominently displayed, "NO LEFT HAND TURN" Where there is any very special trick about a given corner, or the rules there in force, one finds a sign covering the situation. Thus, at the corner where Sixteenth, Arch and the new automobile Parkway converge and cross at a single point, it is not practicable to close any of these streets to through traffic Accordingly there is an ingenious three-way sign at the traffic post in the center of this maelstrom, which states in unmistakable terms, for instance, that at the moment Arch Street is open while the Parkway and Sixteenth are closed From casual inspection from the passing car this appears to be semi-automatic in its operation, the act of putting up the clear sign for one of the three streets which it controls throwing up the blockade indication thus shutting off traffic on the other two thoroughfares without further ado.



A public parking space in which orderly arrangement accommodates a maximum of cars while leaving entrance and exit easy for all

Another novel sign found necessary in Pennsylvania's metropolis is occasioned by the fact that at the center of the city, where Broad and Market Streets meet, there is not the open intersection which one might expect, but rather a big quadrangle, with the City Hall planted in its middle, squarely across the two main arteries of the city's traffic. Around the obstruction there is an extra wide street, and because in this street the through traffic of Broad and Market Streets actually must mingle instead of merely crossing, it has been necessary to make it a one-way proposition. Trolleys and automobiles alike go around it in the clockwise direction only If one comes up Market Street going west and wishes to turn south into Broad, instead of taking the short cut around one corner of City Hall Square, one must circumnavigate three sides of the seat of the city government, going around in the permitted direction until one comes to the desired segment of Broad Street.

Being thus a one-way street, automobiles run on this thoroughfare at both sides of the central trolley tracks, and the problem arises of how an automobile from the inside of the circle can get out, across the stream of trolleys, to go north on Broad Street. This problem is met by dividing the traffic into two classes at the four critical points, by means of a two-way sign one of whose arms reads "Trolleys Go, Vehicles Stop," while the other transposes these conditions. In this way what would be an absolutely hopeless snarl is reduced to a decent and orderly procession.

Complicated crossings like the ones described, however, are getting more and more common in American cities, and as a result, it is found more and more necessary to do two things for the traffic cop He has to have a haven of refuge where he is himself safe from the traffic which he controls, and he has to have a signal apparatus other than mere hand and whistle. It is about these two conditions that most of the inventive talent revolves that is devoted to the problem of traffic con-

(*Continued on page 518*)

The Up-to-the-Minute Laundry

By Charles W. Geiger

THE visiting delegates to the National Laundry Convention recently held in San Francisco, came at a time when there had been developed in that city one of the model laundries of the world. In point of size, hygiene and sanitary arrangements, light and air provision, efficiency of staff organization, economy of plant operation, and for the general contentment of the workers and welfare work, this laundry is without a peer in the world.

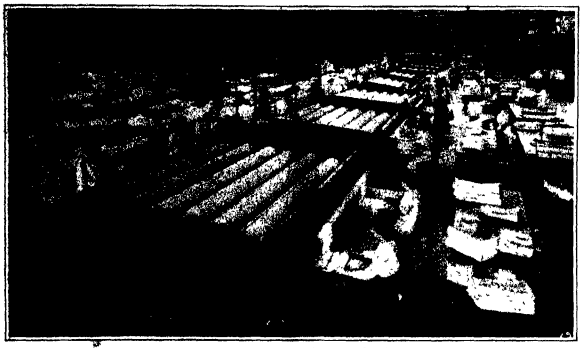
The main building is 275 feet square. It is divided into two immense rooms by a fire wall. All the washing enters at the extreme left of the building, and is discharged ready for the home on the right. The bundles are taken to the marking and sorting departments, and then to the various wash wheels, different washwheels being provided for different kinds of goods.

From the time the laundry is brought to the door of the plant by the driver until it is returned to him for delivery to the owner, the garments are handled almost entirely by labor-saving devices Every unnecessary operation in the handling of the various garments is eliminated by equipment that has recently been installed at a cost of $150,000.

This laundry uses about 400,000 gallons of water a day, secured from its own artesian wells on the prem ises. It also uses about 125,000 pounds of soft soap a week, which is made in a special plant, so situated that the liquid soap is delivered to each battery of wash-wheels by special piping. The wash-wheels themselves have been installed with a device that at a predetermined time, opens the outlet valve in the wash wheel, and then rings a bell after the machine has been drained, and makes a record showing accurately each operation of every load washed, and shows the number of working hours each wash machine produces. By this method one man can take care of an entire battery of washing machines

The water for washing purposes is softened in a specially constructed water softener which is placed at such a height that the water is delivered into seven 20,000-gallon storage tanks (located on the roof of the reinforced concrete and brick power plant) by gravity. From these seven tanks the softened water is delivered by gravity for use in the washing machines.

Every machine in the laundry is operated by electric motors, current for which is generated in a power house with two powerful steam-driven generators A novel feature in connection with these steam-driven generators is the fact that the water from the artesian wells is pumped through the condensers, which not only cools the condensers but also partly heats the water, which is then more effectively dealt with by the water softener.


Finishing room of San Francisco's quantity-production laundry, showing mangles, bundling facilities, etc.

Racing with Model Yachts

By William Henry

THE universal interest in yachting which has been aroused by the International Cup Races, has been extended to the races of the model yachts, which vie creditably in gracefulness with their larger rivals

In Brooklyn, N Y, there is a flourishing gathering of yachting enthusiasts, called the Prospect Park Model Yacht Club, composed of about 30 members, with a beautiful club house built on the shores of the large lake in Prospect Park This house, built of rustic woodwork, while being the headquarters of the club, is also used to house the large collection of model yachts and schooners owned by members of the association. As it is situated on the banks of the lake, it is a simple matter to wheel a model out to the float, lift it out of the cradle, and gently place it in the water, jump into a rowboat and pull out on the lake for a spin.

Racing with model yachts differs from regular yacht races in that the owner follows his yacht in a rowboat, and when he wishes to change tack, rows to leeward or behind and swings the mainsail around by hand, starting it on its new course. Each time he touches the yacht five seconds' penalty is added to the elapsed time.

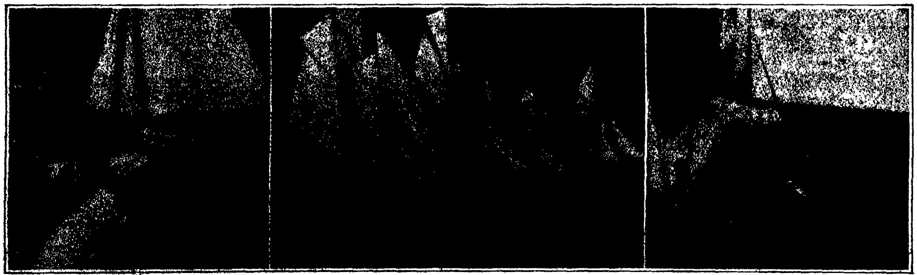
Jockeying for position at the start of a model yacht race

The rudder is connected to the mainsheet by a small cord and the tiller swings between two small nuts, which can be very quickly adjusted to the required position In running before the wind the main sheet is connected in such a way that the tiller is held at the proper angle to sail a true course In beating and *reaching*, the rudder is left free, following the keel of the boat

Races of the Prospect Park Model Yacht Club are held on Saturday afternoons at 3 o clock and on Sunday mornings at 10 o'clock, all the rules of yacht racing being strictly observed

In racing these model boats, they are divided into four classes, as follows 1st class over 48 and under 54 inches load water line, 2nd class over 42 and under 48 inches load water line, 3rd class over 36 and under 42 inches load water line; Schooner class, minimum load water line 36 inches, no maximum

(Continued on page 519)


Left: The club captain and assistant measuring one of the yachts. *Center:* Busy yachtsmen in the clubhouse preparing their yachts for the races. *Right:* Youthful yacht owner adjusting tiller of his yacht for a beat to windward

With the model yacht enthusiasts of Prospect Park, Brooklyn

Concerning Ice

High Pressure Experiments on Water Carried on by Dr. Bridgman of Harvard

SUMMER is at hand and anything cooling is of interest In this connection it may be asked how the reader would like to have a choice of five kinds of ice? The possibility of such a choice is not far away according to recent discoveries in experimental science And together with the new facts about ice other amazing discoveries have been made Among them is the fact that steel can be stretched more than its own diameter before breaking that ordinarily soft and flexible substances are found to increase their stiffness under pressure that water can be decreased in volume almost at will without removing any of the contents

The experiments on high pressure outlined with others are being conducted by Dr I W Bridgman of the Jefferson Physical Laboratory at Harvard University In these experiments pressures were carried up to ten times the firing pressure of smokeless powder in large guns A pressure of 800 000 pounds to the square inch was obtained To visualize this figure in another way it represents the pressure that would be exerted by a body of water 120 miles deep It would take a column of solid rock some fifty miles high to exert such a pressure on its base

Under the influence of such pressure as this substances ordinarily soft and pliable show remarkable stiffness Paraffin wax at 300 000 pounds is more rigid than soft steel A piece of the steel bedded in the paraffin when the latter substance is made to flow under this pressure will go with the stream and become bent and distorted with the wax now harder than itself Soft India rubber it was found at these pressures becomes so brittle that it will crack like glass, and so hard that irregularities in its surface can be impressed upon soft steel

The first subject chosen for the measurement of compressibility was water and in this article attention will be centered on it Water is generally considered almost incompressible but under a pressure of 180 000 pounds to the square inch the astonishing decrease in volume of 20 per cent is produced This phenomenon occurs without the slightest decrease in the actual mass of water present But certain irregularities in the water induced the experimenter to believe that he was measuring sometimes liquid water and sometimes ice

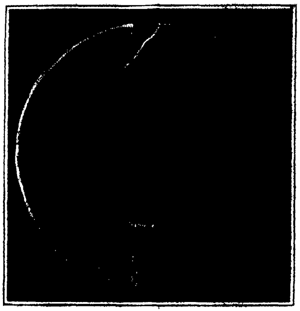
Ice usually weighs less than water, that is why it floats But under the pressures applied by Dr. Bridgman there are four different kinds of ice which are heavier than water Under ordinary circumstances when water freezes to ice there is an increase of volume, but under these high pressures the freezing is accompanied by a decrease in volume with a corresponding decrease in pressure, while when the ice melts again to water the volume increases and the pressure rises.

An interesting by-product of the experiments was the designing of a packing which would keep absolutely tight the vessel in which the pressures were to be produced, preventing the liquid from leaking out. There was absolutely no difficulty in this regard after a while, for it was discovered that with the right packing, the greater the pressure the less can the liquid leak.

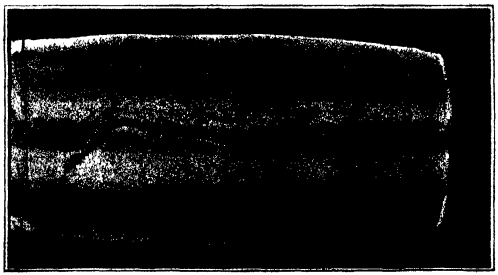
The ordinary screw-tightened packing is certain to leak, because the pressure so exerted cannot possibly equal the pressure of the experiment which exists in the fluid. A packing so compressed will leak as soon as the pressure of the screw is exceeded by that of the water which the packing holds back. But with the simple idea of a packing that tightens itself by the pressure of the vessel, the only limit to the compression that can be reached is set by the strength of the vessel itself The problem was faced with misgivings, for the pressures it was proposed to exert were unheard of with ordinary vessels The second part of the preliminary work, therefore, consisted in finding what pressures a steel vessel would support, steel having been selected as the best material of which to make the container These experiments were not without danger, for in the event of the vessel's failure there would be an explosion that might be serious

In all the experiments the pressures were produced by pushing a piston, by means of a hydraulic press, into the cylinder containing the liquid. Two very interesting problems in relative strength were introduced for the two parts of the apparatus were subjected to different strain In the piston the strain is one of compression, while in the cylinder it is one of bursting, or

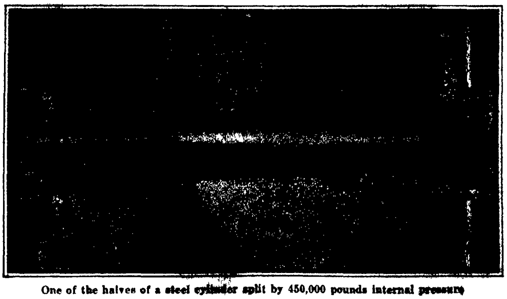
(*Continued on page 519*)



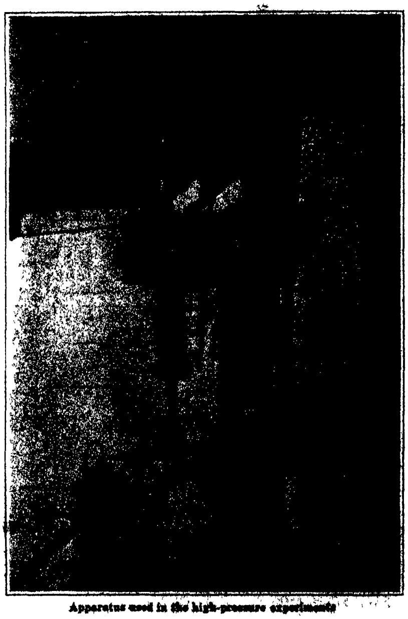
Cross-section of the cylinder shown in the upper left view of the group below



***Outside of a cylinder stretched from .5 to 1.375 inch before rupture.* A cross-section of this cylinder is shown in the upper illustration**



One of the halves of a steel cylinder split by 450,000 pounds internal pressure



Apparatus used in the high-pressure experiments

Handy rack for radiators before or after repair

The Armed and Armored Limousine of a Chinese Governor

AN automobile fortress that is at the same time one of the most luxurious limousines ever built has just been delivered to his excellency Tsan Tso-Lin, the Governor General of Manchuria. The machine, which in appearance and fact is the last word in luxurious transportation, is also an armored car, bullet and bomb proof and prepared either for offense or defense. It is likely to be a model for similar cars for other nervous rulers now that news of its construction is no longer a secret.

When General Tsan appears in the streets of Mukden or other Manchurian cities he will apparently be traveling simply in an amazingly luxurious limousine. The car has disk wheels, special headlights and is of a deep tan color with mahogany top and trimmings Inside, the fittings and finish are fully worthy of the official position of its owner To conform to the colors of Chinese royalty the cushions, seat backs and arms are upholstered in purple and gold mohair. The panels lining the body are entirely of inlaid mahogany, and there are vanity cases of the same material on either side. The fittings and all metal used in the tonneau are of silver and cloisonné. Perhaps the most beautiful part of the interior decoration is the flowered marquetry inlaid in the door panels. In each of these panels more than 20 different kinds of wood are used.

This is the car as it appears to the eye But if an attempt is made by some assassin to end General Tsan's

(*Continued on page 520*)

The limousine that can be instantly converted into a traveling fort

Electrically-driven motion picture camera that does away with the usual cumbersome tripod

Garage Conveniences

THERE is hardly any limit to the scope afforded by the garage for the exercise of mechanical ingenuity Not alone are all sorts of complex problems met in the renovation and the up keep of the cars, but the garage fixtures themselves offer great opportunity for the clever mechanic to put his talents in play And the establishment equipped to do the ordinary and the extraordinary garage jobs with a minimum of time and effort is the one that will capture the business in the long run.

Two interesting wrinkles from a California garage are illustrated on this page. We have all seen radiators knocking around a shop of this sort waiting their turn to be soldered up or remounted, after being repaired, on the cars from which they came There doesn't seem to be any logical place to put these, stand them against the wall, lay them on the floor, even place them aboard their cars, and they are in the wrong place But the boss of this garage has solved the problem. He has built a wooden rack for them, and it is at once clear that in this rack a radiator whether it has had the plumber's attention or not, is exactly in the spot where it is wanted.

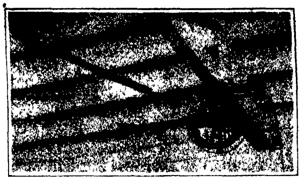
Another garage nuisance—none the less annoying because so necessary—is the air hose You may run over this, where it stretches its snaky length across the garage entrance as it extends from the pump to the wheel of a waiting car, dozens of times without damage to your own tires or to the hose, you may then run over it once more and damage either or both You may also trip over it with more or less disastrous results The garage in which our pictures are taken overcomes all this by putting the air hose overhead, slinging it over a reel that is placed at a strategic point to give it the proper degree of easy mobility The utility of both these simple but seldom thought-of devices is evident at a glance, and the second one might even be installed with profit in the single-car private garage, where some other agent than elbow grease is employed in the pumping job.

A Tripod-less Motion Picture Camera for Aerial Work

THE main thing in making motion pictures is to keep turning the crank at an even speed, two turns per second, no matter what happens. Under normal conditions this is not so difficult to do, but when making aerial views with a motion picture camera the most intrepid cameraman is apt to become irregular on his turns with poor films as a result. What is more, the vibration of the airplane engine is transmitted through the tripod to the camera, with further complications.

Realizing these difficulties in the way of aerial motion pictures, Frank Morris of New York has developed an electrically-driven motion picture camera which is shown in the accompanying illustration. The camera shown here appears to be a French Débrie, somewhat modified and equipped with a 1/20-horsepower electric motor operating on an eight-volt storage battery. An extra large direct-view finder is mounted on top of the camera, while a pair of handles is used to hold the camera steady. Furthermore, the cameraman wears a pneumatic chest pad against which he holds the camera, so as to make for greater steadiness while absorbing all vibration.

Aside from aerial photography the electrically-driven camera may be used in filming automobile and horse races, athletics, sports, and so on, where the lens must be trained on a rapidly moving object.



An overhead reel for the garage air-hose

Using X-Rays to Determine Proper Fit of Shoes

CERTAIN manufacturers endeavor to prove the merits of their shoes by showing photographs of the bones of the feet first in the ordinary shoe and then in their specially shaped shoe Of course, such pictures are interesting, but they fail to leave a permanent impression in most instances, so that when any of us happen in the shoe store for a new pair of shoes, we are guided by the appearance of the shoes rather than by orthopedic considerations Hence, after all said advertising and warnings, we continue to buy shoes that jam and twist and deform the small bones of the feet

Some time ago X-ray machines of a special design were introduced in shoe stores both here and abroad for the purpose of determining when shoes fit and when they do not One of these X ray machines appears in the accompanying illustration The shoe customer, wearing a given pair of shoes, stands on the platform of the apparatus and by looking through the long hood at the top, views the X-ray image of the shoes and feet. The positions of the various bones can be instantly seen What is more, only a low power X-ray tube is used, and ample lead screening is employed to protect the customer and the shoe salesman from injury

It is interesting to note the ever-widening field of X-rays Today X-rays are being used in numerous industries for inspecting materials and goods to detect hidden flaws and to discover causes of trouble in certain apparatus without complete dismantling. For customs inspection purposes X rays have a very definite application, which, as yet, has been hardly touched

Shoe customer studying the fit of a pair of shoes by means of a special X-ray apparatus

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

The Print and Label Law

WHEN the present copyright Code was enacted in 1909 differing views prevailed in official circles as to its probable effect upon the Print and Label Law, but the Attorney General to whom the question was finally submitted for a formal opinion decided that the new act did not repeal that part of the old act which relates to the registration of prints and labels in the Patent Office and that it was the duty of the Commissioner still to register them in the same manner as before Until therefore higher authority decides otherwise, it remains for the Patent Office to treat the Print and Label Law as valid and subsisting as a part of the general copyright law The rule seems to be that if the article has enough merit and value to be the object of infringement, it is rightly to be deemed of sufficient importance to be entitled to protection

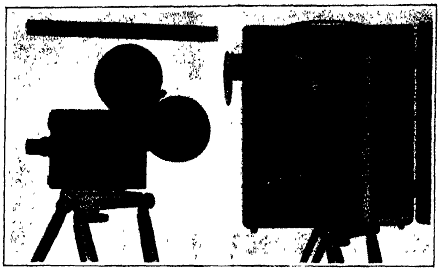
In addition to these fundamental requisites, prints and labels must also qualify under the rules of interpretation evolved by the Patent Office For many years the Office construed the word "print" as being synonymous with "label" and required that the label must be free from any feature or device capable of sequestration as a trade mark But a more liberal rule now prevails It is recognized that a label stands on a different footing from a print in that it is affixed to the goods, while the print must be separate from the thing it portrays or advertises If either device has some artistic quality and indicates (pictorially or otherwise) the article or contents of the article for which it is used, it is deemed registrable for copyright protection regardless of the fact that it may include trade mark features as well, provided it is not in fact a mere technical trade mark

The print or label must possess just as much artistic quality as would be necessary to entitle it to registration in the Copyright Office if it were not "designed to be used for any other articles of manufacture" The term "other articles of manufacture" is construed to mean articles of merchandise or vendible commod-

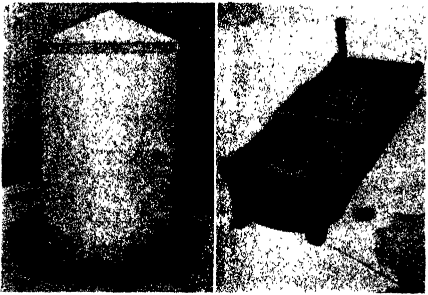
(*Continued on page 521*)

Teaching Table Manners to the Pig

TABLE manners among hogs are not apparently a matter of great importance But the fact is that the hog which gets the right amount to eat fares better than the one that does not, and that regulation of the style in which the animal attacks his fare has something to do with this, espec[illegible] if it prevents one of the litter from eating its own share and that of another. So H W Force of Berkeley, Cal., has invented an automatic feeder for Mr Pig and his family The device holds sufficient food for the hog menu for about two weeks The action of the apparatus occurs through pressure of the hogs' noses against its base, this pressure causing the individual compartments to be filled with a proper individual ration These compartments are separated from one another, as shown, by galvanized iron partitions, and since the food drops gradually into the compartment, instead of filling it all at once, the habit of the greedy hog, of eating his own and his brother's meal, is checked By the time his own is gone the rest of the family will have dined too In connection with the automatic feeder is used an automatic hog trough with a float that keeps the water at a constant level so long as the trough is connected with supply line.



Miniature camera with magazine mounted for use and a rule to indicate the relative size in inches, and the miniature projector with case open to show mechanism



Automatic individual feeder and automatic water-trough for use in the hog pen. The one insures that each hog shall get his proper ration and no more; the other that there shall be water at a drinkable level so long as the supply holds out

Reproducing the vibration of the car in the battery-testing room by means of a spring suspension that simulates the action of a bouncing car

Motion Pictures in Miniature Form

A FAVORITE field for inventive talent is motion pictures, more particularly that branch of the art that has to do with the reduction of costs so as to extend the scope of motion pictures in all directions

There is no denying the fact that motion pictures in the standard forms are too expensive for most amateur industrial and educational applications. Standard sized film costs a good deal of money—4 cents for the negative film, 2 cents more for development, and 5 cents more for the positive print, which is the one used in the projector, or something like 11 cents per foot in all. At that rate motion pictures are too expensive for use in the home, in business, and in our classrooms, as a general thing

The latest attempt to bring down the cost of motion pictures consists of a tiny camera and a suit-case type of projector, shown in the accompanying illustrations. The film for this system is about half the width of the standard theatrical size, with perforations on either side of the images The film is of acetate of cellulose stock, which is slow-burning or entirely safe for use anywhere, without restrictions of any kind. The camera has a pair of magazines mounted at the rear, as shown, containing the unexposed and the exposed film A simple outside spring belt operates the take-up magazine The crank can be arranged for the usual eight-pictures-per-turn movement, or the single-picture-per-turn or trick movement. The finder lens is mounted directly above the photographic lens, in the camera case itself. The photographic lens is of the fixed focus type, cutting clear pictures on all subjects from three feet to infinity. By means of an ingenious clamp and universal joint holder the little camera can be mounted on the side of the automobile windshield ready for instant action.

The projector is entirely self-contained It weighs but nine pounds, making it convenient for the use of salesmen and travelers It can be set up on the same tripod that is used for the camera. At a distance of 18 feet the tiny projector gives a clear picture measuring 3 by 4 feet. An incandescent lamp of high-efficiency type is used as the illuminant.

"Shimmying" the Storage Battery

A VIBRATION board which operates with a "shimmying" effect has been designed and built by the national Bureau of Standards for the testing of storage batteries This testing equipment differs from previous designs in that the batteries are jolted by the movement of springs, thereby more nearly duplicating the conditions with which they are surrounded in actual practice. The influence of jarring on the life of the battery as well as the relative durability of different types will be revealed by this newly-constructed apparatus.

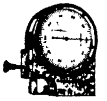
The "shimmying" motion is obtained by a simple eccentric or cam action, the eccentric being keyed to the shaft of a motor and transmitting the movement downward against spring tension. The springs are visible in the illustration and the battery is seen in place on the board subject to vibration. The motor is quartered under the controller box which is on a platform. A field rheostat, on a rack, regulates the speed of the motor, its range of frequency being from 800 to 1,200 revolutions per minute. A tachometer is seen at the extreme left of the photograph, while the cam operating the vibration board is under cover between battery and motor.

THE SCIENTIFICALLY BUILT WATCH

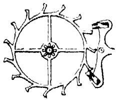
OLAF OHLSON
Inventor and Master Watchmaker

ACCURACY

The Various Dimensions of the Escape Wheel must not vary One Half-Thousandth of an Inch



Jaw Gauge



Escape Wheel

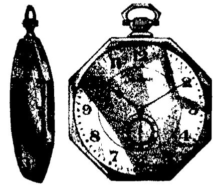
DIVIDE an inch into two thousand parts and you have the limit of measurement variation allowed by Waltham in making this important wheel.

For example, the impulse surface of the escape wheel tooth is a vital factor for an accurate performance, and when made within the limit of measurement variation allowed by Waltham, it means the difference between variable and dependable time-keeping in your watch.

Waltham horologists invented, and devoted years to perfecting, gauges that would measure so precisely these various important factors of the escape wheel. The variation which is present in the foreign hand-made watch has been eliminated in the Waltham.

Therefore, we affirm that the Waltham Watch contains the world's most accurately made escapement. This is frankly admitted by leading horologists, and is one of the reasons why the Waltham Watch is famous for its close and dependable time-keeping.

The Waltham Watch contains more fundamental superiorities in its "works" than any other watch in the world. When you buy a Waltham your investment is protected and you are assured of a life-long satisfaction.



Waltham (Octagon) Opera Watch

A gentlemen's time-piece
Extremely thin without sacrificing accuracy
$95.00 and up

This story is continued in a beautiful booklet in which you will find a liberal watch education. Sent free upon request to the Waltham Watch Company, Waltham, Mass.

Makers of the famous Waltham air friction quality Speedometers and Automobile Time-pieces used on the world's leading cars

WALTHAM

THE WORLD'S WATCH OVER TIME

Where you see this sign they sell Waltham Watches

With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

Protection of Life Against Fire

THE protection of human life from fire has often been overlooked or given only secondary consideration by building designers and owners. Buildings which are fairly safe for the material stored or manufactured therein do not always offer equal security to the occupants. During the last ten years several serious fires, involving heavy loss of life, have attracted general attention, so that today more thought is being given to this subject.

To protect the occupants of buildings, it is necessary first to prevent fires, as far as possible, and then to provide means for extinguishing or controlling a fire, if it occurs, as well as to provide proper exits, alarms, and drills.

While all states and many cities have fire escape laws or ordinances, many of these are quite out of date, and seemingly ignore the tragic lessons taught by the Triangle Shirt Waste Company and other holocausts regarding the inadequacy of old style fire escapes. In only a few states can the employer feel assured that, by complying with legal requirements, he has actually given his workers a fair chance to escape in case of fire. Whether required by law or not, every factory or other work place should have at least two exits from each story of sufficient size for the number of persons accommodated so designed and constructed that the occupants can and will use them if a fire occurs.

Those forms of exits are best which protect property as well as life, and which increase, rather than decrease, the convenience of the building for ordinary use. No exit, however, is efficient unless it is always ready for immediate use, and unless, when used, it will lead the occupants to safety.

Various forms of exit are:

(a) Horizontal exit—a door through a fire wall, or an outside balcony or bridge leading to another building or division. (b) Exterior enclosed stairs—cut off from the building, and reached by balconies or vestibules. (c) Interior en-

(Continued on page 521)

Severe test of an industrial tractor with the new duplex compensating suspension, and a detailed view of the power axle and suspension of this machine

A New Duplex Compensation for Industrial Tractors

THROUGHOUT the development of the automotive industry, the problems of properly correlating the driving axle to the chassis mechanism have engaged the attention of engineers to an extent equal to that of the power plant design. The problem has been to provide a means of resisting the severe strains and stresses arising from the functions of braking and driving without at the same time restricting the action of the supporting vehicle springs.

A new construction, unique in many ways, designed to restrict braking and driving strains, with due regard to the requirements of spring suspension, is found in certain electric industrial tractors and trucks now being manufactured in this country. The duplex compensating suspension employed in the new construction relates particularly to the torque members used, the chassis frame being supported on double concentric helical springs which provide the necessary cushioning effect. The principle involved, however, would be one adaptable to other forms of motor vehicles with more conventional automobile spring equipments.

The helical springs referred to above are loosely mounted in pockets cast in the chassis and axle members and support the chassis load only. Swivel studs, free to oscillate in their retaining sockets, hold the helical springs under proper compression when the vehicle is light and resist the tendency of the chassis to rebound off the springs when traveling over a rough surface. These spring studs, thus tying together the chassis and the axle, are not rigid in their seats. Flexibility for the spring suspension is provided within the limits permitted by the torque resisting devices.

The forward torque member of the new construction is supported by trunnions from the chassis frame and takes all driving and braking strains through a large ball-and-socket device attached to the motor cradle, which forms an extension of the axle housing. A second similar construction mounted in a horizontal plane above the power unit holds the axle in alinement and resists all axle thrusts resulting from forward or backward motion of the machine.

The two flexible constructions permit the driving power unit freely to perform its functions under all conditions of road surface without loss of traction or power efficiency and without the cramping or binding of any of its parts. The axle supports the chassis load through its cushioned springs, and is free and flexible to perform its one specific and vital function—delivery of driving or retarding power to the vehicle.

It has heretofore been extremely difficult to devise any system of guides or other strain-resisting devices within the restricted space available, which would successfully stand up under the heavy work required and provide the flexibility necessary for ideal traction and power efficiency. The present construction has been given rigid tests in some of the most exacting industrial tractor and truck applications existing, and it is generally recognised that some applications of industrial machines are more severe than those encountered in automobile or motor truck work. While the speed of the machines is less, they are frequently operated in close quarters, are frequently bumped full tilt into heavy objects, and their rapid operations require abrupt braking and starting characteristics. It is claimed that in this most severe service the new torque resisting mechanism above described has proved itself a valuable improvement over other torque-resisting and spring-suspension mechanisms that have been used heretofore.

The Magnetic Clutch

THE direct pull of an electro-magnet holds together the friction surfaces of the usual magnetic clutch, which is used for connecting and disconnecting machinery from its source of power. When the circuit through the electro-magnet is closed, the clutch is engaged; when it is open, the clutch is disengaged. One member of the clutch contains the magnet coil which, when energised by an electric current, pulls the other member into contact with it. The contact is made on a friction surface, which is carried by a flange on the outside of the first member. As long as the electro-magnet is energised the two members rotate as a unit. When no current is flowing through the coil, the two members stand a short distance apart and a positive running clearance is provided.

Magnetic clutches have been on the market for the past twenty years and are employed in many different industries in various ways. They are built in sizes from 7 inch diameter to 78-inch diameter, and are used to transmit from 1 to 2,000 horsepower. However, the magnetic clutch has a far wider range of applications, especially if its possibilities were more fully realised.

The principal features of a typical magnetic clutch may be summed up as follows.

()1 Direct magnetic action, which results in a simple, compact structure with no toggles, levers and so on to wear or get out of order.

(2) Ease of operation: It is only necessary to close or open a switch to engage or disengage the clutch. This switch may be located at any convenient distance from the clutch and may be operated either manually or automatically.

(3) Smooth acceleration: In the short interval of time necessary for the magnetic pull to build up to its full strength the friction surfaces engage gradually, there being sufficient slip to secure a smooth start.

(4) No end thrust: No end or side thrust is transmitted to the shafts or connected machinery. The magnet pull balances the pressure between the friction surfaces.

(5) Fixed capacity: For each size of clutch there is a fixed capacity depending on the known pull of the magnet;

A Federal 3½-ton tractor, equipped as shown with Caterpillars, was the only one able to pull three loaded trailers on grades during the winter, two tractors equipped with other tires having failed even when shod with chains. Only two trailers appear in the picture above but this tractor has more than once pulled three whose loaded weight totalled 14½ tons. Owned by City of Syracuse.

The tire that walks away with the load

The one quality a truck tire *must* have is ability to get traction.

Mileage is important and resiliency desirable, but unless the tires are able to dig in their toes and push when the engine's power is delivered to the wheels, they might as well not be on the truck.

Few trucks are operated under ideal conditions; in sand, in snow, in mud or on wet, slippery asphalt, you've got to have something on the wheels more efficient than smooth bands of solid rubber.

Solid tires are becoming obsolete. Big pneumatics are expensive and undependable. There is only one tire that in all kinds of weather and over all kinds of roads can carry the truck wherever the driver wants it to go, and do it at a lower cost per mile than either the plain solid or the big pneumatic.

That tire is the Caterpillar. It is made in sizes suitable for trucks of every type and weight.

Kelly-Springfield Tire Co.
GENERAL SALES DEPARTMENT
1710 Broadway New York

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc

Pertaining to Apparel

HOSE SUPPORTER.—R. M. SILVA, 48 Hoyt St., Brooklyn, N Y An object of the invention is to provide a supporter in which *substantially all the pull or strain* is taken off the hose thereby eliminating the possibility of ripping and pulling threads in silk or delicate texture Another object is to provide a supporter in which by a simple adjustment it is adapted for use either in connection with a sock or stocking, and connected with a body garment which tends to keep the garment from slipping out of place

Electrical Devices

SEPARATOR FOR STORAGE BATTERIES —W M STUDEBAKER and H J. EPPLE, 426 E 6th St., Erie, Pa. The invention particularly relates to separators formed of spun glass Among the objects is to form a separator which is sufficiently flexible to prevent breaking under the warping of the electrodes, and of requisite porosity to insure an evenly distributed penetration of the electrolyte to all parts of the electrodes.

ELECTRIC HEATER —E VERSTRAETE, 10 Railroad Ave, Newark, N J The general objects of the invention are to provide an arrangement of external electrical resistance, and to provide a heater which while capable of use for heating generally, such as heating a room, is especially adapted for bringing water or other liquid almost instantaneously to an exceedingly high degree of heat.

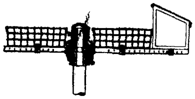
ELECTRIC DOOR LOCK —G DEEG, 341 S 21st St., Irvington, N J The invention has reference more particularly to a door lock having mechanism operated by electricity so that the door may be locked from a distant point. The object is to provide a lock which is adapted to prevent the exit of a thief from a bank, store or other building by pressing an electric button at a distance from the door

Of Interest to Farmers

HAY PERFORATING DEVICE.—O D NOLEN, 305 Hermitage Ave, Nashville, Tenn The invention more particularly relates to bale perforating devices by which hay is perforated as it is baled, an opening being formed centrally through the bale in order to provide for access of air to the center o fthe bale and in this way defeat molding from moisture The device is capable of attachment to the baling head of an ordinary baling press.

Of General Interest

MAIL RECEPTACLE SUPPORT.—F McDILL, Sparta, Ill This invention is particularly designed for use in rural districts The prime object is to provide means for revolubly supporting a plurality of mail containers from a single supporting standard, whereby the standard may be positioned within a fence at one side of the road. Another object is to so construct the device as to prevent rusting or freezing of the movable elements



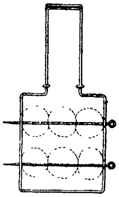
A FRAGMENTARY SIDE ELEVATION WITH PARTS IN SECTION

RAT GUARD —G J HART, 78 Read St., New Haven, Conn The particular object of the invention is to provide a rat guard which may be readily positioned upon a ship's hawser to prevent rats from crawling aboard the vessel, and may be readily removed. The device is simple, strong and durable, and automatically maintains its upright position on the hawser.

ARTIFICIAL HAND —R F ARMSTRONG, La Cygne, Kan An object of the invention is to provide an artificial hand capable of performing all the important functions of the human hand and in which the movable parts are positively actuated and maintained in operative *movements* and *positions respectively*, while being easily controlled by the wearer

BOOK FILLER —A R TOWERS, 411 American Bank Bldg, Richmond, Va This invention has for its object to provide a book filler having all the advantages of a bound and sewed flat opening book with the added features of the loose leaf book in that the filler may be attached or detached at will from the binder.

TOASTER —C. WILSON, Waynesburg, Pa Among the principal objects is to provide a toaster which is constructed in such manner as to permit of its being either suspended in front of a grate, or the laying of the same on the heated surface of a stove for supporting food, to provide a toaster especially designed and adapted for toasting marshmallows, but which may be utilized for toasting bread or other articles of food



A PLAN VIEW OF THE TOASTER

COUPLING —C A BORGERSON, 3640 16th St., San Francisco, Cal The object of this invention is to provide a device especially adapted for connecting hose to box hydrants, the arrangement being such that the usual bend in the hose where it leaves the water pipe will be eliminated, and wherein the hose may be freely rotated about the hydrant

BERRY BOX —E E OGDEN, 312 Eye St., Hoquiam Wash Among the objects of the invention is to provide a box of the character specified, wherein the box is composed of two strips of suitable material, capable of being folded one into a frame, and the other into shape to form a bottom coöperating with the frame and supported thereby without the necessity for securing means of any character

SHOWCASE —W P HIMES, New Bethlehem, Pa. The invention relates to store furniture, its object is to provide a show or display case more especially designed to be set against a wall which is extremely strong and durable in construction and practically moistureproof. Another object is to permit of readily assembling the parts in setting up the show case.

MOP HEAD —G H SUNDERMANN, 4189 White Plains Ave, Bronx, N Y The aim of this invention is to provide mechanism permitting of the mop proper being gripped in such a manner that any possibility of the strands becoming loosened is reduced to a minimum A further object is the provision of a device the parts of which may be operated to permit of the ready gripping or disengagement of the mop.

WATCHCASE —L LUBIN, c/o Galdberg & Lubin, 61 Beekman St, New York, N Y An object of this invention is to provide an arrangement of angular watchcase especially adapted for use in connection with wrist watches in which the movement frame supports any shape of movement in any shape of frame, the back center being *correspondingly* shaped in accordance with the shape of the movement and the case so as to cover or fill up space at the outside of *the movement* in the case

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How the Lower Animals See

(*Continued from page [illegible]*)

and greatly magnified. The compound eye of the lower animal doubtless was designed to see objects at very close range and to see them relatively magnified. This is at once evident from its structure, its shape and its size. Indeed a more perfect adaptation could *not be fancied*; *for the vast* majority of animals with compound eyes being small creatures themselves have to do in their pursuits and various modes of living with things still smaller, and it was therefore necessary that nature supply what art could not devise.

Many insects have, besides compound eyes, what are known as ocelli, or simple eyes. They are usually three in number, and are arranged in a triangular manner on the head between the compound eyes. Little seems to be known regarding the *function of these organs beyond the fact* that they enable the owners to utilize the darkness with greater facility than those insects not so equipped It is notable that bees and their allies, moths and spiders—although the last named is not properly an insect—are all animals which either work at night or in dark situations and have the ocelli well developed.

It has been proposed recently that the ocelli may act as stabilisers whereby the insect by keeping the sky uppermost, maintains a horizontal position during flight. But recent *experiments*, wherein the simple eyes were coated with asphaltum have controverted this idea; the asphaltum treatment seeming in nowise to have affected the equilibrium of the insect's flight.

It has often been observed that the eyes of moths and other night-flying insects have the peculiar property of shining in the dark, after the fashion of the house cat's This feature is supposed to be due to a tissue underlying the retina, and is known as the *tapetum* The function of the *tapetum* is *to* intensify the dim light entering the eyes of the night-workers by reflection

Certain it is that the lower animals cannot see very far. Guided mainly by scent, the range of their activities does *not* require a vision which reaches beyond their immediate neighborhood The eyes of the lower animals are in many respects like their other organs of sense—for assistance in the gathering of food and detection of the too near approach of their natural enemies Beyond these purposes, which they serve quite well, they are neither adapted to a keener vision nor is this necessary

Tricks of Traffic Control

(*Continued from page 510*)

trol Philadelphia itself, for instance, puts the officer up on a circular concrete platform high enough to protect him from anything short of a deliberate attempt to run him down. For day time use, as suggested by the preceding paragraphs, she supplies him with a manually operated signal bearing printed instructions and incapable of being made to contradict itself. For the dark hours of the evening she supplies him with a searchlight of such power that no careless driver can present the excuse that he didn't see the traffic signal until too late to heed it.

A variant from the New York pattern of traffic tower is the one attributed to Knoxville, Tenn These booths are at the top of a single steel standard placed between the trolley tracks. There is one at the intersection of each pair of prominent streets; but unlike New York's towers, they operate independently, being designed only to give the officer at each corner a better view and better signaling means. White lights are flashed for traffic to proceed, red to stop; green indicates the rare condition when the corner is open in all directions. At the peak of each booth is placed a horn which can be turned, like a weather vane, in any direction. In the event of fire this is used to scream its warning down the street which the engines will traverse and clear the path for the fire apparatus. In addition to this, a certain element of coöperation is found in the telephone that joins each officer to the men immediately north, south, east and west of him. In this way, if a driver violates rules at one corner and gets away from the officer there on duty, he can be held up at the next, or the one after that, or at the very least his number can be got for future attention to his case. But to officers and drivers alike, the isolation and protection afforded the traffic guardian is the most appealing feature of these booths. With an electric fan and electric heater, the occupant of the booth can defy sun and snow; with a roof over him rain is nothing in his life. And this means even more to the traffic than it does to him, for traffic regulation from these booths works just as effectively in the slippery weather when danger of accident is at a maximum as on the fine days when visibility and car-control are at their best

We have spoken of the difficulty which the driver may have in distinguishing the traffic officer and his signals at night. On streets that are not a blaze of illumination this condition is even more marked. Dr *Harriss*, the inventor of the block-signal system of traffic control now practiced from the traffic towers of Fifth Ave., New York, has met this situation by designing a clever portable light-signal outfit that makes the traffic officer a regular human signal tower. The illuminated cop, as one of the local newspapers calls him, wears over his shoulder a rubber apron, to the low-cut front of which is attached by two hooks a little signal box containing three lights and the batteries necessary to run them. The lights are red, yellow and green, and are operated by push-buttons in the bottom of the box. As the satirical reporter puts it, "No motorist, steering his purple assassin homeward through the tearful glimmer of a languid dawn, will be able *to* miss an illuminated cop Whether or not the motorist is lit, the cop will be." Seriously, every motorist has been embarrassed at times by the difficulty of making out the ordinary traffic signals in the dark, and this device ought to be of much utility at points where it is not convenient to erect a tower.

A phase of the traffic problem that does not get so much attention as that of street-corner control is summarized in the query "Where do all the cars go?" As one stands at a busy corner and watches the cars stream down into the business section of the city, whether it be a dead-end business center with no exit at the other side like New York's or whether it be open from both ends like Philadelphia's, one must wonder what is done with all these cars after they have discharged their passengers. Some of them go on through the city or turn around and go back whence they came; but a glance at the curbs is sufficient indication that plenty of them are parked right in the streets until they are wanted again. As a matter of fact, the universality of this custom is sufficiently attested by the success with which it has added a word to our language A decade ago the man who had asked where he might "park" his car might well have been taken for a traveling prestidigitateur who proposed to transform his automobile into a patch of green grass Today the word is an accepted part of the regular speech, and is even creeping into our slang, so that if we wish we may park our feet under the table, or park our weary carcass in the bed.

So universal is the custom of leaving the car unattended in the streets that the mere use of signs prohibiting parking near corners, in front of theaters and restaurants and close to fire hydrants is not enough. In many towns the signs set an upper limit to the time of parking, and the police make a more or less effectual attempt to enforce this. In many more the nuisance has got to such a point that it has been necessary to institute recognized public parking plots. Those who attend the ball games in New York know perhaps the most extensive of these—we have seen half a mile of the Speedway curb banked solid with cars, backed in as close together as the prohibition against two bodies occupying simultaneously the same space would permit. But in the more crowded sections of New York and other cities there are no extensive curb areas available for parking in this fashion. It is therefore necessary to utilize to the utmost whatever of open space there may be at hand. Our final picture shows how this is done in one instance. In a wide and little used street chalk lines are carefully laid down, so that two double ranks of cars may be parked without interfering with the entrance or exit lines. This is economy of space carried to the last degree.

Racing with Model Yachts

(*Continued from page 511*)

In the Regatta races boats sail according to class; but in the point races class is not taken into account Prizes are given to the winners for the season

The Prospect Park Model Yacht Club at present is made up of former members of the Brooklyn Model Yacht Club and the Yankee Model Yacht Club, who agreed to join into one organization for at least six months. This plan has worked out very well and will no doubt result in a permanent organization probably under the present name.

The enthusiasm of the yacht races is not confined to the older members of the club, the younger members being fully as expert yachtsmen. On the large lake at Prospect Park, the triangular course is five-eighths of a mile, and on the windward and leeward course the yachts sail a half-mile by covering their course twice Some excellent scores have been made over this course Thus the schooner "Fairwind" covered the triangular course in 12 minutes 55 seconds The "Hilma" covered the same course in elapsed time 18 minutes, or 15 minutes 17 seconds by corrected time.

Quite a lively sight is the start of one of these races when more than half-a-dozen of the yachts are jockeying for the best position to cross the line, while on the shore opposite the stake stands the timer with his watch and recording tablets, keeping accurate account of the time each one crosses.

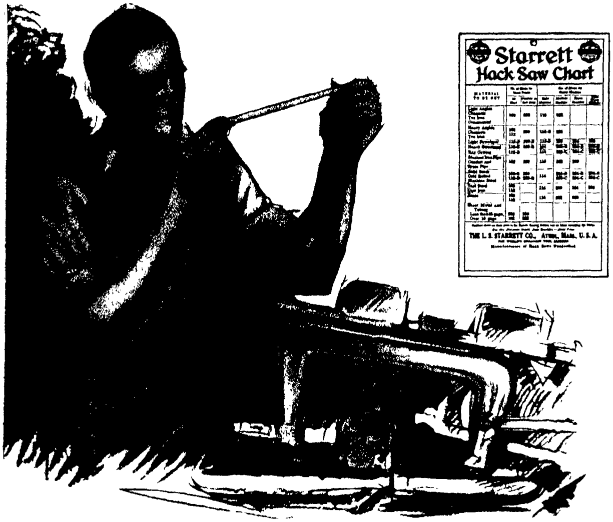
Collisions happen frequently, but they are not usually serious, the damage being easily remedied In a heavy wind the yachts heel over to an alarming degree, but thanks to their deep lead keels, always right themselves. So great is the speed of the large yachts that the owners frequently have to put in some hard rowing to keep up with the diminutive but fast-moving craft.

Concerning Ice

(*Continued from page 512*)

tension. The problem of the strength of the piston did not prove of difficulty, for it was found that the compression supported by a piece of glass-hard steel held rigidly is surprisingly large Several grades of steel were found which would support a compression of 600,000 pounds and one grade stood up under as much as 750,000 pounds per square inch.

No theory of the strength of a cylinder was of much value for very high pressures. It is of no use to make indefinitely thick walls, nor indeed to make them more than a certain thickness; for the inside layers support most of the pressure in any event. The outer layers of a very thick cylinder do not take up the stress from the inner layers. Dr. Bridgman concluded that the best way to make a cylinder support a high pressure was first to stretch it on the inside by applying a much higher pressure than it was intended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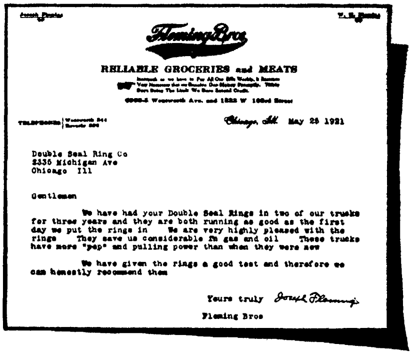

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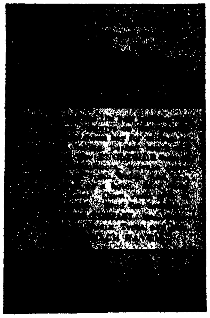

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to maintain in practice. It was found that a cylinder treated in this way is in a state of internal strain, exactly as is a gun which has had hoops shrunk on it from the outside. As a result of the experiments a cylinder half an inch in diameter was stretched to 1.2 inch in diameter before breaking and the break, when it came, started on the outside.

In the preliminary work on steel cylinders many cylinders were broken. This gave opportunity for interesting observations on the manner of rupture at high pressures, and two facts not to be expected from ordinary theory were noted. The same specimen of steel which stretched more than its diameter under pressure, if tested for strength in the ordinary way would have broken when the strain became about 30 per cent, whereas the strain here was about 140 per cent before rupture took place In all cylinders tested the break started at the outside, where the stress and strain were both least. There is reason to believe, however that very brittle substances like glass would break on the inside, as predicted by the ordinary theory The determining factor here according to the experiments, is the plasticity of the substance

Another important factor was the devising of some means of accurately measuring the pressures. None of the ordinary pressure gages were found to be of the slightest service at these high pressures. Again, strange to say the very simplest method that can be conceived proved to be the best. It consists in inserting a steel piston through a hole in the wall of the cylinder and measuring the force necessary to prevent it from being blown out by the pressure within

The minute the preliminaries were concluded and the actual experiments with water begun it was found that the high pressures made the water disobey all the ordinary rules The application of ordinary pressure to ice causes it to melt. But when ice is subjected to pressure at temperatures lower than ten below Fahrenheit, it is no longer possible to make it melt but instead it changes in form, passing over into another kind of ice more dense than water instead of less dense like ordinary ice

The pressure required to produce this second kind of ice is about 33 000 pounds per square inch These two forms of ice are comparable to the two forms of carbon—graphite and diamond with this difference the new kind of ice changes to ordinary ice the moment the pressure on it is relieved just as ordinary ice changes to water on the provision of sufficient heat Old principles are borne out, however and old reasoning supported, by the fact that when the ice is of less density than water the freezing point is lowered by the application of pressure while if the ice is of the denser-than water variety pressure raises the freezing point.

The Armed and Armored Limousine of a Chinese Governor

(*Continued from page 518*)

term of office with a bullet as is so frequently the fate of Chinese officials, the car can be transformed in a twinkling Down from inside the roof come steel shutters covering all the windows and reaching to the steel plates built inside the walls of the car Concealed loopholes open on each side and in the rear and six automatics or rifles can come into action Another steel shutter rises out of the partition between the tonneau and the driver s seat, closing off danger from the front. A Colt machine gun appears from under the driver's seat and is fastened on to a special bracket built in at the right hand side of the cowling. The luxurious car is thus turned into a fortress.

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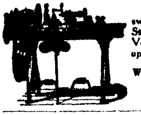

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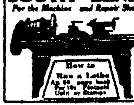

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The Print and Label Law

(*Continued from page 514*)

ities, substantially as in the trade-mark law. Consequently a design to be placed on letter heads, cards, etc., as mere ornamentation and not being itself suggestive of any other article of manufacture, was denied registration; as was also a print designed to be used as a marker for a highway, though the same might be eligible for registration at the Copyright Office as "pictorial illustrations or works connected with the fine arts."

The word "designed" in this connection does not refer to the state of mind or intention of the author, but to the subject-matter or quality of the print or label itself, and if that subject matter does not suggest or in some manner identify the particular goods for which it is used, the work is not registrable in the Patent Office.

The Commissioner must determine for himself whether or not the work presented is registrable as a print or label and his decision, even though erroneous, cannot be reviewed by mandamus proceedings. But no nice application of rules will be made in the Patent Office to determine the degree of artistic quality displayed by the print or label; it will be registered as a matter of course when recognized to be of a character which is commonly regarded as the result of artistic or intellectual effort, or which might properly be so regarded. Registration will only be refused if the article belongs to that class which is not intended for the production of artistic effect on the beholder and which does not in fact produce any, as where the label consists only of printed text with directions for use of the contents of the box or bottle to which it is applied.

On the basis of the foregoing principles the present rules of the Patent Office define a *print* as "an artistic and intellectual production designed to be used for an article of manufacture and in some fashion pertaining thereto, but not borne by it; such, for instance, as an advertisement thereof", and a label as "an artistic and intellectual production impressed or stamped directly upon the article of manufacture, or upon a slip or piece of paper or other material to be attached in any manner to manufactured articles or to bottles, boxes, and packages containing them, to indicate the article of manufacture." No print or label can be registered unless it properly belongs to an article of manufacture and is descriptive thereof and is as above defined; but no examination will be made as to its novelty.

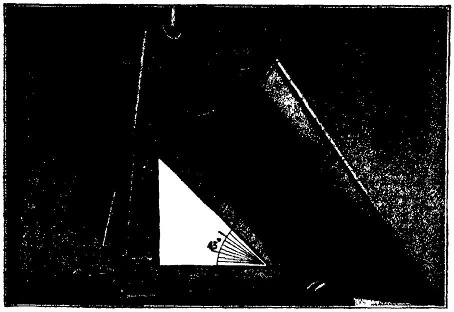
Protection of Life Against Fire

(*Continued from page 516*)

closed stairs—fire resisting enclosure with fire doors (d) Interior stairs—not enclosed (e) Elevator (f) Outside stairs—not enclosed (g) Outside fire escape, stairway type (h) Outside ladder (i) Special forms of fire escapes, such as chutes, poles and ropes.

The horizontal exit is believed by most fire protectionists to be the best for the protection of life, especially where there are a large number of persons on one floor. The occupants, after passing through a fire door or across a bridge are in a protected area from which they may descend in safety without excessive haste. Adequate stairways must, however, be provided for moving the occupants to the ground level as soon as they have passed through the horizontal exit,

(*Continued on page 523*)



Stopped, locked or lowered from any angle up to 45°

There is no gradual "settling" of the raised truck body when it is held by a Van Dorn Hoist.

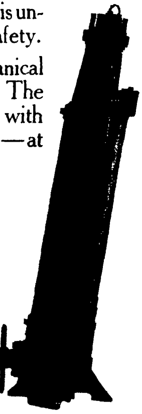
Stopping the hoist, firmly and positively locks it, and the body will be held rigidly in any angle until it is *pulled down* by the same power which raises it. Gravity plays no part in the operation. Work can be performed on the chassis under the raised body with perfect safety.

Operation of the Van Dorn Mechanical Hoist is automatic in every detail. The hoist is started, stopped or lowered with the body at any angle up to 45°—at which extreme dumping angle it automatically stops. The truck can be driving away with the body lowering—the hoist stopping and disengaging automatically when the body settles to its bed.

Complete bulletin descriptive of Van Dorn Mechanical Vertical and Horizontal Hoists, and Truck Bodies sent to any truck operator.

Write

THE VAN DORN IRON WORKS COMPANY
Cleveland
Branches Long Island City, N. Y., and Philadelphia
Distributors in all other cities



Cut away view of the Van Dorn Mechanical Hoist showing the screw jack principle of operation and the automatic lubricating device

Van Dorn Mechanical Dump Truck Hoists: Bodies; Frames; Pressed Parts

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Note.—Illustrated articles are marked with an asterisk (*). Look for the general subject rather than the supposed specific title of any article. Thus: "Aeronautics," "Automobiles," "Meteorology," "Canals," etc., will give related articles much more quickly than by reference to the title of the article.

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DELUXE
The Successful Light Weight Piston
PATENTED U.S.A.
FOREIGN PATENTS PENDING
LOOK INSIDE YOU CAN'T GO WRONG

Do You Own a Car?

DELUXE light weight, cast iron pistons will increase the power, speed and flexibility of any motor and at the same time use less gasoline and oil They also reduce repair bills by eliminating vibration Thousands of motorists in every part of the world are proving this every day

DELUXE PISTONS ARE 40 TO 50% LIGHTER
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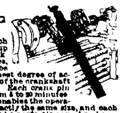

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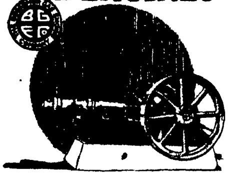

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BESSEMER OIL ENGINES

Protection of Life Against Fire

(Continued from page 521)

because there is a possibility of the fire spreading to a floor beneath them, and because the fear of fire may result in a panic.

The exterior enclosed stairway, or "smoke proof tower," completely separated from the building by a fire wall, is the safest medium for people down, because it cannot be seriously obstructed by smoke from a fire on a lower floor As such stairways must be reached from each floor by means of an outside balcony, they are generally not suitable for everyday use. They are desirable as emergency exits in high buildings, especially where there is inflammable material. Some laws require this type of stairway under certain conditions

The interior enclosed stairway, commonly found in modern buildings, is surrounded by fire resisting walls or partitions, the entrance at each floor being protected by a fire door Such stairways are efficient both as fire exits and for every-day use They are not quite so safe, in case of fire, as an outside enclosed stairway, because they may be obstructed by smoke if a door is left open

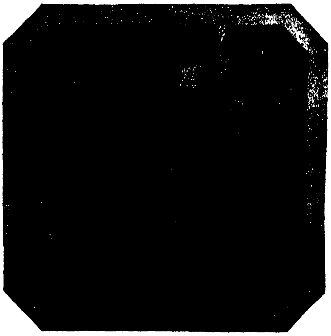
The stringers, treads and risers of all the foregoing types may be made of fireproof material or of wood

Open stairways and elevator shafts cannot be depended upon as fire exits They act as flues and quickly spread the fire from one floor to the next In new buildings of more than two or three stories open stairs should not be permitted In existing buildings it is advisable, especially if there is a considerable number of occupants, to enclose the stairways with fire-resisting partitions Such enclosures not only safeguard the occupants, but also protect the building and its occupants by preventing the rapid spread of fire from one floor to another In the case of single-run stairs, the enclosure should include a passageway on each floor, from the foot of one stair to the top of the next stair, so persons may go from the upper floors to the street without leaving the enclosure

Outside open stairways, for general use, are often seen on two or three-story factories These are better exits, in case of fire, than the ordinary fire escape, because the occupants are accustomed to using them Each outside stairway should, if possible, be covered by a roof to keep off snow and rain Wooden stairways are not recommended, they require frequent inspection, and repair or replacement when they begin to rot

The so-called stairway-type fire escape is simply an outside stairway for emergency use Many fire escapes built only "to comply with the law" show several or all of the following defects Flimsy construction, excessive openings between platform bars, inaccessibility from workrooms or public passageways, lack of fireproof windows to protect against fire in lower stories, lack of extension to street level, use on high buildings where height causes panic, unsafe condition caused by lack of maintenance, snow and ice, and obstructions Fire escapes are also open to the following general objections as compared with enclosed stairways. They furnish no protection to property, they add nothing to the convenience of the building for daily use, and, being never used except in emergency, when emergency and panic come the occupants often forget or do not know how to use them It is nevertheless true that a stairway fire escape—preferably called an outside stairway—if properly designed, located, constructed and protected, is a safe, efficient exit

The National Safety Council of Chicago has prepared several bulletins on the subject of the protection of life against fire, and it is from some of these bulletins that the foregoing information has been abstracted. These bulletins are obtainable in loose-leaf form



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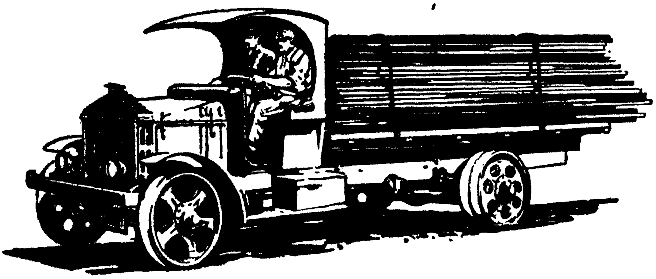

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Pierce-Arrow has ten years' experience with over 20,000 trucks in actual road service. The service organization has watched minutely these trucks perform. This knowledge was used in designing the present line of trucks so that

They last and keep running at a minimum cost and upkeep expense. They do more work, make more trips and make each trip in minimum time.

They carry maximum effective loads and are always ready for service. They can be easily run with the least wear and strain.

Pierce Arrow

CHASSIS PRICES

2 -ton	$3750
3½-ton	4950
5 -ton	5700

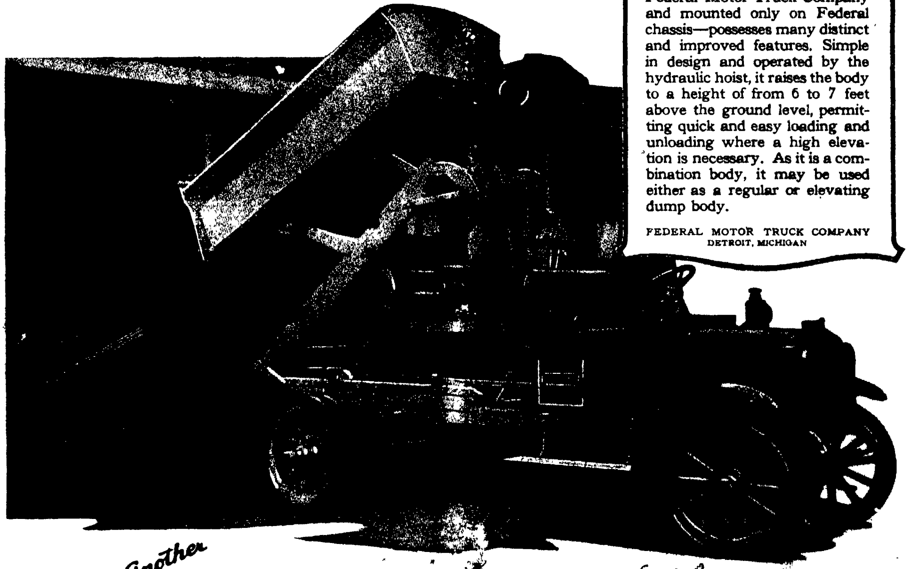
All Prices F.O.B. Buffalo

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.

To produce a *better* truck at a *reasonable* price is only the first service of Federal

Making this truck perform its task more easily, quickly, and more cheaply is the second

This exclusively Federal elevated dump body, for instance, permits Federal to serve in a manner and in places where others cannot—



The Federal Elevating Dump Body in Action

The Federal elevating dump body—a product of the Body Designing Department of the Federal Motor Truck Company and mounted only on Federal chassis—possesses many distinct and improved features. Simple in design and operated by the hydraulic hoist, it raises the body to a height of from 6 to 7 feet above the ground level, permitting quick and easy loading and unloading where a high elevation is necessary. As it is a combination body, it may be used either as a regular or elevating dump body.

FEDERAL MOTOR TRUCK COMPANY
DETROIT, MICHIGAN

Another
FEDERAL (54)

One to
Seven Tons
Capacities

I. A. R. I. 75

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